POWER

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ELY C. HUTCHINSON, *Editor*

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The Veteran Workman

SEVERAL correspondents complain of the difficulty in finding employment when one has passed middle age.

There has been a very considerable reduction in the number of man-hours of human labor necessary to keep the world going on a given scale. If everybody is to have a chance to earn a living we must either live more elaborately or work fewer hours.

We have been doing both. An increasing number of young people are going to high school and college. Automobiles, radios, movies, victrolas, cameras, electrical appliances and all sorts of things that people got along without a few years ago are in common use. The average person wears better clothes and sits down to a better table.

And, on the other hand, we have the 8-hour day and, in some industries, the 5-day week and the growing disposition, complained of, to lay men off or avoid employing them after middle age.

The number of hours that one works in the course of his life may be reduced by shortening the day or by earlier retirement.

Is it better that one should work 5 hours a day for 50 years or 8 hours a day for about 31 years?

Of course, he should receive the same total emolument in either case. An 8-hour day is not onerous for a young or middle-aged man. He would complete his term of labor earlier and retire when he needed rest, and could enjoy leisure with assured maintenance for his remaining years.

The man who lives an hour away from his work would in a life's service of 75,000 hours spend the equivalent of 40 per cent of the time he labored in going back and forth, provided he worked but five hours a day, or 25 per cent if he worked 8 hours.

With the growing expectancy of man's life span there would soon be a large element of the population consisting of retired people with the time and means to devote themselves to whatever pursuit appealed to them.

There are plenty of inexpensive homesites lying idle but made accessible by the automobile and comfortable and convenient by electric service, radio, postal facilities, etc., awaiting the use of those who prefer a country to a metropolitan life.

Their well-being depending upon the income from the invested surplus earnings of their productive years, those so retired would be interested in the maintenance of peace, order, efficiency and prosperity.

Is there a more promising ideal to work toward than the enjoyment of surplus time?

Unhappily there is little help and comfort in this for the veterans of industry who have had but a living wage and are still dependent upon their day's work. It must be urged that the industries to which they have devoted the best part of their lives shall not sacrifice them in an overreach for efficiency. Their experience is often more valuable than a personnel manager realizes and years of faithful service deserve gratitude and recognition.

F. R. Low

EDITORIALS

Georges Claude And "Sea Power"

LAST WEEK, in the news section, *Power* said, "Claude Predicts Sea Water Plant at Cost of $60 per Kilowatt." Beneath was reported the meeting at which Georges Claude addressed 800 engineers in the main auditorium of the Engineering Societies Building, New York City.

Fresh from his experiments in Cuba, Claude made a deep impression on his engineer auditors. Here certainly was a great man—A.S.M.E. medalist from France—inventor famous for air liquefaction, ammonia synthesis, and the popular Neon lamp—a man whose practical achievements had left their marks around the globe. A lone figure, Claude appeared, fighting for the soundness of his ideas against the whole world, often victor over nature where inevitable failure had been predicted.

Dramatic in the extreme was Claude's portrayal of his struggle against man and nature in the attempt to prove that the great heat reservoirs of tropical seas invite commercial exploitation as a source of power. Here was a man who refused to "take a licking" in the face of harrowing difficulties. At enormous cost he twice built and launched great sea-water tubes, only to see them torn from their moorings and sunk as total losses. The third, fortunately, found its proper place and brought from the bottom cold water to condense vapor evolved from the warm surface water.

Critics had pointed in derision to the fact that the turbine delivered but twenty-two kilowatts with an auxiliary power consumption of eighty. Here Claude's contention that a turbine ten times as large could have been accommodated with the same auxiliary power is worthy of consideration.

But, without belittling one of the great men of our age, the practical engineer must still suspend judgment, awaiting answers to certain questions. Has Claude solved the problem of economical air removal from the condenser? How has he arrived at his estimated cost of sixty dollars per kilowatt? Has he included a fair price for turbines designed to operate with highly attenuated vapor? How long will the tube and insulation last in sea water? These are fair questions. Until they are answered, the experiment cannot be pronounced a commercial success.

In the meantime, all fair-minded engineers will wish the best of luck to Georges Claude in this audacious attempt to tap the heat of the ocean.

Smoke Abatement And Politicians

A WELL-KNOWN engineer, who has to his credit successful smoke-abatement efforts in several cities, recently lamented the fact that constructive work of this character is so often overturned by politics.

Another man who accomplished the task of smoke abatement in one of our largest cities, and carried on successfully, expressed the opinion that it is possible to forestall political interference by adopting an uncompromising attitude from the start.

Both spoke from experience and both were right, but there are other factors.

Politicians are human. It is part of their trade to secure preferment in return for party support. They are not to be blamed. The onus rests on the plant owner who, while considering himself a helpful member of the community, seeks to secure special license at the expense of the community's welfare. He must be converted to the proper viewpoint.

The difficulty in many cases has been one of sustaining popular interest to back up smoke abatement and maintaining this interest to the point of assuring sufficient annual appropriations. Popular interest is easily aroused, but is restless and soon turns to new issues. Moreover, a campaign cannot be waged indefinitely. Such being the case, it is necessary to convince the plant owner that it is to his economic advantage to operate without smoke, and to sell the idea so completely to all concerned that annual appropriations will be forthcoming without question, just as they do for health, fire and police protection. Where such a condition can be brought about the politician need not be feared.

Industrial Refrigeration Offers Wide Opportunities

THE ADVANCE PROGRAM of the annual convention of the National Association of Practical Refrigerating Engineers, to be held next week, features several papers on industrial application of refrigeration. The association is to be congratulated on its willingness to face facts and to realize that refrigeration is no longer solely confined to ice making.

The refrigerating machine manufacturers would do well to follow the engineers' path and devote more attention to the development of industrial uses of their equipment, rather than to place undue effort on improving ice-freezing methods.

The household machine concededly is winning general favor, and arguments against it on the basis of having a greater cost compared to ice are futile, for, as with the automobile, the radio and the oil burner, the convenience factor overshadows the cost differential.

On the other hand, almost daily, industry is finding new uses for refrigeration, and the field of application would be greatly extended if the manufacturer were to give it more attention.

Mongrel Metrics

IT OFTEN happens that ill-considered efforts to simplify life merely add to the general confusion. In this class falls the plan, reported from Washington, to "rationalize" metric-English unit conversion by legalizing the meter at 40 in.

This proposal might have some merit if the United States and the British Empire were in such a primitive industrial state that the present standard inch could be junked and a new inch exactly equaling the fortieth part of a meter could be made an actual physical standard by law.

However, the proponents of this measure have nothing so revolutionary in mind. They would leave the inch and meter exactly as at present, merely legalizing a "conversion ratio" that would not hitch with the actual facts.

Actually, a meter would continue to be 39.37 in., and an inch 25.4+ mm. The new law, if passed, would simply insist that they were something else, regardless of the facts.

Such legerdemain brings to mind the Western Solon who proposed to make π exactly equal to 3 by legislative fiat, in the face of the fact that nature fixed it at 3.1416+.

The reason for the new proposal doubtless lies in the difficulty attending multiplication and division by 39.37 and 25.4+. The practical answer is that law or no law, one may approximate as much as he pleases for his own private purposes. The accuracy should fit the problem. A man buying cloth may, if he wishes, use the round number of 40 in. for a meter without falling into serious difficulties. But if, with the aid of the proposed law, people ever get the idea that a meter is equal to 40 in. they will be due for a rude awakening.

See where it leads: One meter is exactly 40 in. An inch is exactly 25 mm. (on paper). Fine stuff! The American manufacturer decides to make a shaft that will fit a bearing of French manufacture. French drawings show a 25-mm. bearing. The American says, "Aha, very simple, exactly one inch." He turns his shaft 0.997 in. for a running fit. But when the customer tries to run this shaft in the French bearing he discovers the difference between reality and a pretty legal fiction. No amount of mathematical hocus pocus will make a 0.997-in. shaft run in a 0.982+ in. bearing.

The metric system deserves better than this at the hands of its friends.

Checking Welds

ALTHOUGH welding is now employed extensively in power plant work, especially piping, it is surprising to note how widely practice differs in checking the character of the work. With the personal element regarded as the most important factor in securing good welds, some companies subject their welders to periodic examinations; others find an initial examination, plus occasional check tests of routine work, sufficient to insure satisfactory results; whereas some plants do not deem it necessary to employ either examinations or tests. Again, there are many companies which have their welding done by outside contractors and rely largely upon the latters' reputation.

That some have managed to get along with little or no control does not prove that supervision is needless. An imperfect weld may hold up for a number of years under the stresses of normal operation, but eventually fail through fatigue or shock. It is for this reason that some companies insist upon microscopic inspection rather than depend upon a tensile test through the medium of hydraulic pressure.

Fortunately, current developments are providing means for more readily examining the character of welds, and the personal element may soon be less of a factor.

POWER *Stands for . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application
8. Prevention of Smoke, Within Reason

Difficult Design Problems Solved at

MINNESOTA VALLEY STEAM STATION

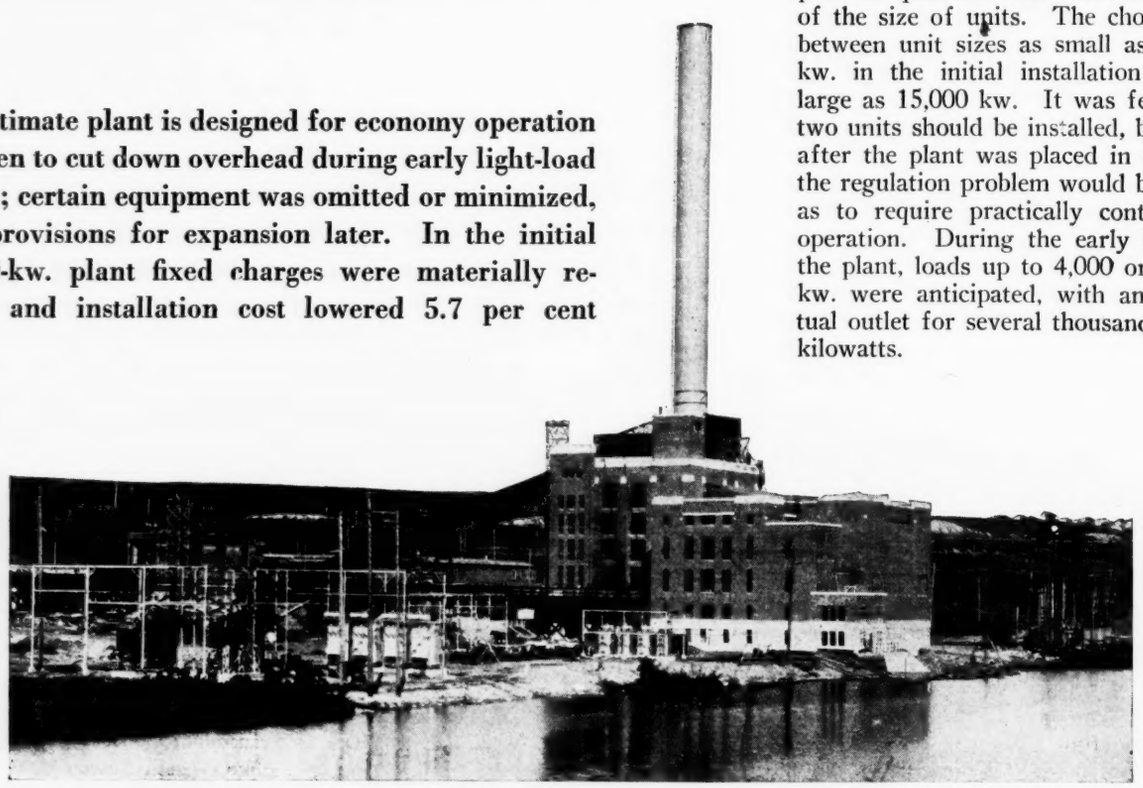
The ultimate plant is designed for economy operation and then to cut down overhead during early light-load period; certain equipment was omitted or minimized, with provisions for expansion later. In the initial 20,000-kw. plant fixed charges were materially reduced and installation cost lowered 5.7 per cent

IN THE Southwestern Division of the Northern States Power Company there was need for a new steam station that initially would relieve the strain on the existing transmission system, supplied by a combination of steam and water power, and eventually carry load up to its dependable capacity in contributing to the service of an important and growing section to the southwest of Minneapolis and St. Paul. Maintaining more satisfactory regulation of the voltage supplied adjacent areas was the first consideration. With the plant once in service operation would be continuous, but the load small for the first few years, with the added complication that during certain seasons of the year and certain times of the day it would be desirable to develop as little load as possible at this plant.

Original estimates indicated that for the first few years the plant might have an annual output of 20,000,000 kw-hr., equivalent to a capacity factor of 11 to 12 per cent. Consequently, one of the major objectives was to hold fixed charges on the initial plant to a minimum, because it would be difficult to justify more than the bare necessities. More recent developments in the program have indicated that the transmission systems radiating from this plant will progress more rapidly than was at first expected. It was considered probable that within two years a reasonably substantial output would be required; so provision had to be made not only to increase plant capacity, but also to add equipment that would result in the attainment of better economy.

Procedure was to design the ultimate plant and then determine what features could be left out and what equipment could be minimized with provisions for expansion later, to hold down the initial cost and the overhead during the early, light-load period of its existence.

Selection of a definite site for the plant was a problem that had a limited number of solutions. Minnesota River, which runs through a portion of the area concerned, has in this vicinity a flow that limits the ordinary development to approximately 30,000 kw. Desire to avoid construction of retaining dams to provide an adequate pond elevation at the plant to permit of operation during low-water periods eliminated all but one possibility—the site finally chosen, which is on the pond of the existing Minnesota Falls hydro plant, within the city limits of Granite Falls. Railroad facilities there also influenced the decision. In preliminary plans the next important question was determination of the size of units. The choice lay between unit sizes as small as 5,000 kw. in the initial installation to as large as 15,000 kw. It was felt that two units should be installed, because after the plant was placed in service the regulation problem would be such as to require practically continuous operation. During the early life of the plant, loads up to 4,000 or 5,000 kw. were anticipated, with an eventual outlet for several thousand more kilowatts.

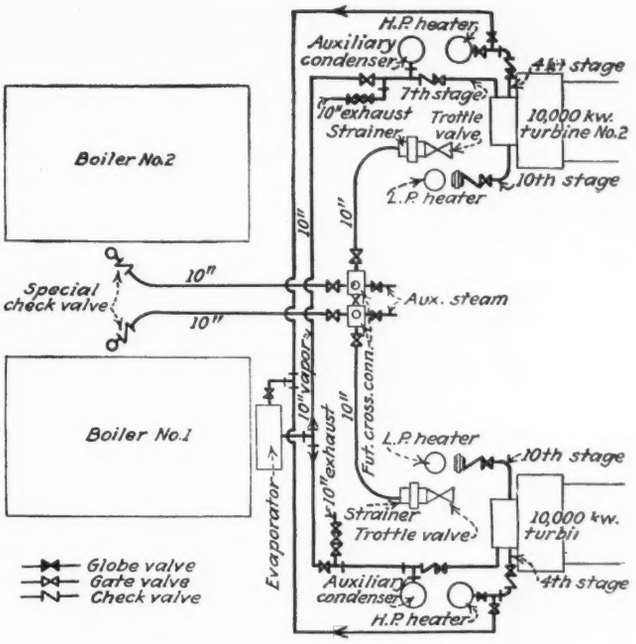


As the ultimate capacity of the plant was limited to approximately 30,000 kw., a unit size of 10,000 kw. was chosen. Initially it was decided to install two boilers, each capable of carrying 7,500 kw., and to make provisions so their capacities later could be increased to carry 10,000 kw. by the addition of economizers, water walls and induced-draft fans, in addition to increasing the number of retorts in the stokers.

Two 13,500-sq.ft. boilers of Stirling type were selected, equipped with convection type superheaters and seven-retort underfeed stokers with link-grate section and clinker grinders. The clinker grinder shaft is made long enough to permit the installation of additional rolls when two more retorts are added to the stokers. The stokers are 33 tuyères long, which with the link-grate section is equivalent to 45-tuyère stokers. For the present draft is supplied by a self-supporting steel stack 14 ft. in diameter and 256 ft. high.

In the electrical generating side of the plant, the possibility of designing the two turbines to carry 7,500 kw. each, with the capacity later to be raised to 10,000 kw., was considered; but the expense involved made it appear more economical to use machines designed for the ultimate load.

In the condenser auxiliaries a saving was effected by providing each condenser with a circulating-water pump capable of furnishing approximately 50 per cent of the amount of water that would be required with the turbine carrying full load. Operating in parallel, these two pumps will be capable of supplying the required amount of water for one condenser, and the addition, when required, of a third pump of full capacity will provide for full-load operation on the two condensers. A reduction in investment also was effected by omitting some of the surface in the condenser, the holes in the tube sheets being plugged until such time as the load would require the installation of the remaining tubes. It has been estimated that the omissions would lower the initial installation cost about 5.7 per cent and thus materially reduce the fixed charges.

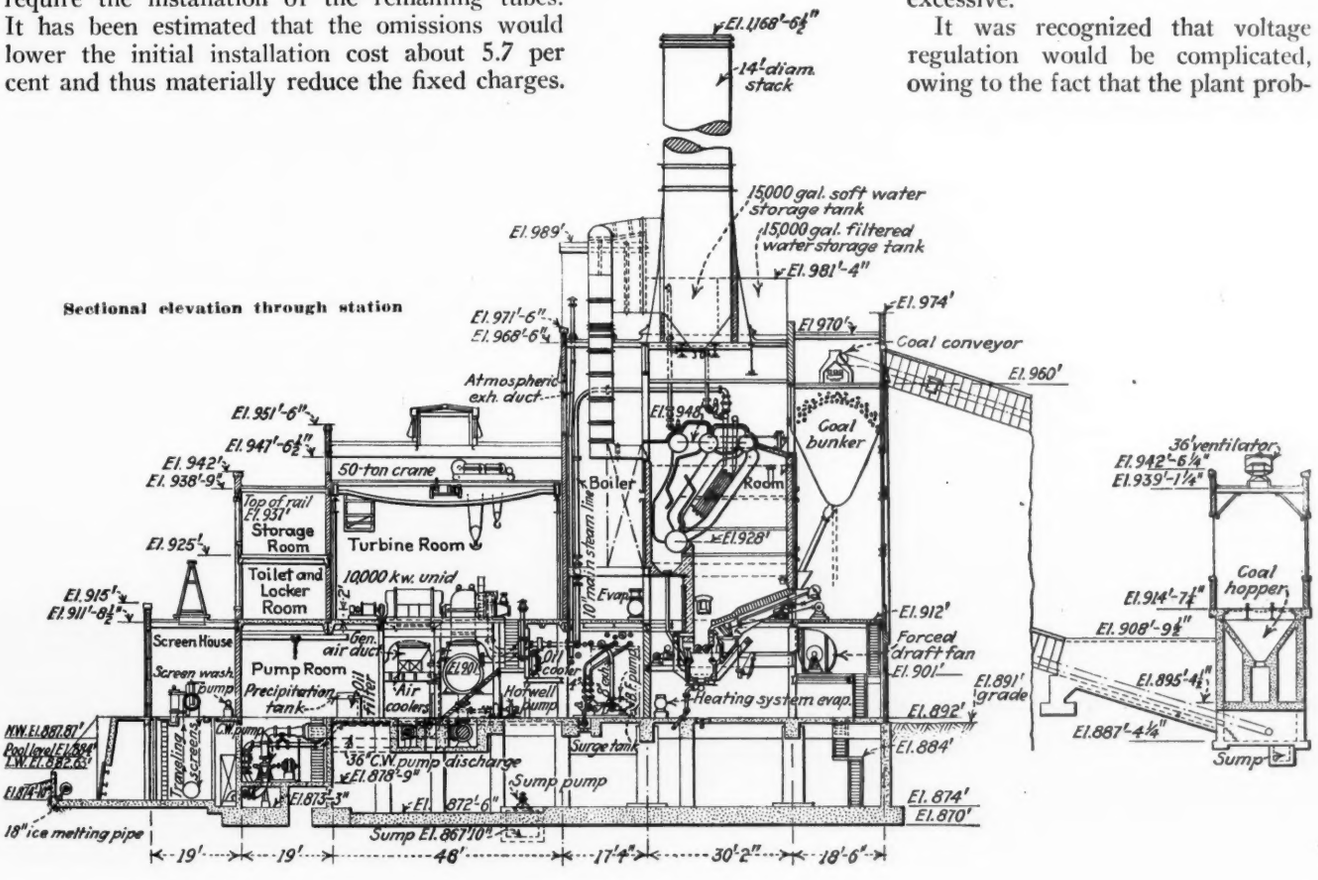


Main and extraction steam piping

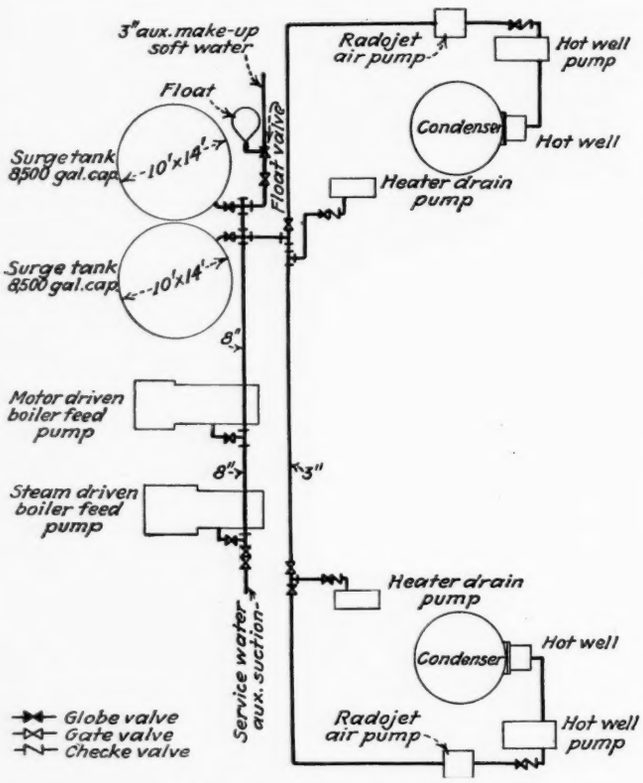
The electrical layout of the station was subjected to close study. At first it was planned to install outdoor switching and transformer equipment. From a service standpoint the operating organization favored a double bus with oil circuit breakers on each position, and, taking into account local climatic conditions, preferred indoor construction for a voltage that would not require excessive clearances. A preliminary study had shown that the cost of such equipment for operation at the generated voltage, 13,800, would not be excessive.

It was recognized that voltage regulation would be complicated, owing to the fact that the plant prob-

Sectional elevation through station



ably would supply directly no load whatsoever at its generated voltage and would be dependent entirely upon transmission lines and transformer banks to distribute its output to points from 15 to 160 miles distant. Light loads at certain seasons of the year and at certain times of the day introduce more complication. To meet these conditions each transmission line has a set of regulating transformers manually controlled from the Granite Falls switchboard. This arrangement permits independent regulation of each of the 66,000-volt lines going out from the station. Otherwise, it would be virtually impossible



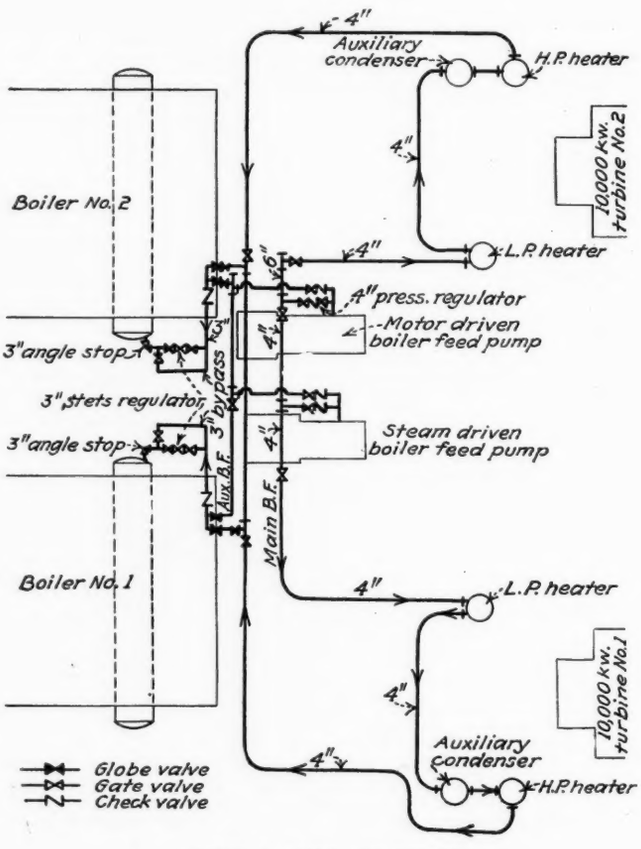
Condensate system up to feed pump

to control the flow of wattless current throughout the system.

Reference to the sectional elevation will show the general layout of the station. The mud drum of the boiler is set 16 ft. above the operating floor level. Provision is made for an ultimate furnace volume of 8,100 cu.ft., giving a ratio of 0.707 cu.ft. per square foot of boiler heating surface and a heat release of 21,400 B.t.u. per cubic foot at normal rating of 120,000 lb. of steam per hour. In the initial installation the furnace walls have been corbelled in to accommodate the seven retorts, but they will be straightened when the water walls and the two extra retorts are added. The elevation of the boiler room was planned to handle ashes at grade level by industrial cars or small motor trucks. Constant-speed induction motors operate the stokers through hydraulic-drive and silent-chain combinations. The clinker rolls have an independent motor drive at the back of the setting. Hydraulic oscillators on the coal chutes insure uniform delivery to the stoker hoppers. The forced-draft fans are in a sealed compartment under the firing floor, and a duct connection from the plenum chamber conveys air to the rear of the furnace to complete the combustion of the carbon in the ash. Ash hoppers are of steel, lined with gunite, and are equipped with air-operated gates. Fine-coal hoppers recover the siftings from the stokers.

Coal is received in a special unloading building over two hundred feet from the plant. From the track hopper, it is fed by a pan conveyor, with a magnetic separator on the headshaft, to a single-roll crusher. Delivery is to an inclined belt conveyor running to the top of the boiler house, which transfers to a longitudinal belt conveyor over the bunker equipped with a self-propelled self-reversing tripper.

Water for the plant comes in through a screen house at the bank of the river, equipped with the usual trash racks and traveling screens. In front of the screen house is a concrete basin, or forebay, with a floor 9 ft. below the pool level. Flaring wing walls widen the intake to slow up entrance velocity, so that suspended matter will tend to settle in the basin. Both condenser circulating-water and service-water pumps are adjacent to the screen house, and draw their supply from the screen house well through short suction connections. Condenser supply is carried through a 36-in. underground pipe and returned to the river through a pipe of the same dimension and an open trench discharging downstream about 500 ft. from the intake. During the winter months an 18-in. line car-



Layout of boiler feed system

ries part of the condenser discharge to the intake basin to keep the inlet water above freezing temperature.

Water from the service header first passes through pressure-type gravel filters and may be pumped directly to one side of a 30,000 gal. roof tank divided at the center by a steel partition. One side of the tank gives 15,000 gal. filtered-water storage for plant use and the other half furnishes storage for an equal amount of softened water, obtained by passing the water from the

Present Mechanical Equipment of Minnesota Valley Plant, Northern States Power Company

Boilers, two, Stirling, water-tube, 350 lb. pressure, 725 deg. F., 11,462 sq.ft. of surface each, 90,000 lb. steam per hr. ..... Babcock & Wilcox Co.
Furnace walls, firebrick ..... A. P. Green Fire Brick Co.
Furnace volume, cu.ft. 7,400
Heat release at normal rating, B.t.u. per cu.ft. 19,000
Superheaters, two, convection type, 725 deg. F. when boiler delivers 90,000 lb. per hr. ..... Babcock & Wilcox Co.
Stokers, two, underfeed, seven-retort, link-grate overfeed section, double-roll clinker grinders, hydraulic drive, Westinghouse Elec. & Mfg. Co.
Clinker grinder drives, silent-chain and motor, Westinghouse Elec. & Mfg. Co.
Stoker chute oscillators, two ..... Coal Spout Oscillator Co.
Soot blowers ..... Diamond Power Spec. Corp.
Feed-water regulators ..... Stets Company
Blowoff valves ..... Yarnall-Waring Co.
Safety valves ..... Consolidated Ashcroft Hancock Co.
Boiler check valves ..... Byllesby design made by Crane Co.
Water columns ..... Yarnall-Waring Co.
Stack, self-supporting steel, 14x256 ft. ..... Minneapolis Steel & Mach. Co.

Meters

Boiler meters ..... Bailey Meter Co.
Draft gages ..... Bailey Meter Co.
Thermometers, recording ..... The Bristol Company
Thermometers, indicating ..... C. J. Tagliabue Mfg. Co.
Pressure gages, indicating ..... Consolidated Ashcroft Hancock Co.
Leakage detector, condenser water ..... Esterline Angus Co.

Coal and Ash Handling

Track scale, four sections, 50 ft. effective rail ..... Howe Scale Co.
Locomotive crane, 55-ft. boom ..... American Hoist & Derrick Co.
Apron feeder, 30 in., 100 tons per hr., magnetic separation ..... Link-Belt Co.
Coal crusher, 24x30 in., single roll, 100 tons per hr. ..... Link-Belt Co.
Belt conveyors, two, 24 and 30 in. ..... Link-Belt Co.
Industrial cars, two ..... Western Wheeled Scraper Co.
Ash gates, double unit, power operated, water collecting ..... Allen-Sherman-Hoff Co.
Receiving hopper gates, rack-and-pinion operated slide type ..... Link-Belt Co.

Feed-Water System

Softener, zeolite system, 30 g.p.m., 8 ft. diam., 10.5 ft. high, 100 lb. working pressure ..... The Permutit Co.
Filters, pressure type, gravel, 6 ft. diam., 4 ft. high, 100 lb. pressure ..... The Permutit Co.
Evaporator, single effect, submerged tube, 200 sq.ft. surface, 5,000 lb. per hr. ..... Croll-Reynolds Engrg. Co.
Closed heaters, four, vertical, floating-head type; low press, 540 sq.ft.; high press, 415 sq.ft., 2-pass., Croll-Reynolds Engrg. Co.
Auxiliary condensers, two, vertical, floating head, 540 sq.ft., two-pass ..... Croll-Reynolds Engrg. Co
Heater drainers, four ..... Atwood & Morrill Co.
Heater drain pumps, two, 70 g.p.m., 45 ft. head, 1,800 r.p.m., motor drive ..... Pennsylvania Pump & Comp. Co.

Boiler Feed and Service Pumps

Boiler feed, two: One 4-stage Cameron, 400 g.p.m., 1,038-ft. head, 2,600 r.p.m.; drive, 175-hp. G.E. turbine. One 5-stage Cameron, 400 g.p.m., 1,038-ft. head, 1,750 r.p.m.; drive, 200-hp. motor ..... Ingersoll-Rand Co.
Service pumps, two, 500 g.p.m., 160-ft. head, 3,600 r.p.m.; drives, one 40-hp. motor, one 30-hp. Terry turbine, Worthington Pump & Mach. Corp.

Turbine-Generators and Auxiliaries

Turbine-generators, two, 10,000 kw.; turbine 13-stage, 3-stage extraction, 3,600 r.p.m.; steam conditions, 300 lb., 725 deg. F.; generator, 3 phases, 60 cycles, 13,800 volts, dir.-con. exciter ..... General Electric Co.
Generator air coolers, two, 11,580 sq.ft. ..... General Electric Co.
Oil filters, two, 3-compartment storage tank ..... S. F. Bowser & Co.
Condensers, two 10,000 sq.ft., two pass. ..... C. H. Wheeler Mfg. Co.
Circulating pumps, two, 5,000 g.p.m., 20-ft. head; drive, 40-hp., 440-volt, 730-r.p.m. Amer. Elec. Co. Motor, C. H. Wheeler Mfg. Co.
Condensate pumps, two, 180 g.p.m., 80-ft. head; drive, 20-hp., 1,800-r.p.m. Terry turbines ..... C. H. Wheeler Mfg. Co.
Air evactors, two, twin, inter- and after-condensers C. H. Wheeler Mfg. Co.
Traveling screens, two, 18 ft. c. to c. ..... Chain Belt Co.

Miscellaneous Equipment

Crane, turbine room, 50-ton, 4-motor, 46-ft. 2-in. span, Whiting Corp.
Monorail hoist, boiler room, 5-ton ..... Jos. T. Ryerson & Son, Inc.
Monorail hoist, pump room, 2½-ton ..... Jos. T. Ryerson & Son, Inc.
Air compressor, one, 257 c.f.m., 100 lb. ..... Ingersoll-Rand Co.
Pipe, valves and fittings ..... Crane Co.
Motor valve operators ..... Limitorque Corp.
Insulation, boilers and piping ..... Smith-Totman Co.

filters through a zeolite system before pumping it to the elevated tank on the boiler room roof.

A closed feed-water system requiring no open or deaërating heater has been provided. It consists of two closed extraction heaters receiving their steam from the fourth and tenth stages of the turbine and from an auxiliary condenser connected in series that receives the vapor from a single-effect evaporator supplying pure make-up. Exhaust from the steam-using auxiliaries also goes to this condenser. To maintain the heat balance the condensate pumps are turbine driven. One of the two boiler-feed pumps is turbine driven, and the other motor driven. The same arrangement also applies to the service pumps.

Two vertical surge tanks of 8,500 gal. capacity each are connected in parallel to the condensate system to absorb any inequality between supply and demand. As these tanks are the vulnerable points of the condensate system for the admission of oxygen, they are provided with flat floats that rest on the surface of the water. The upper portion of each tank is blanketed with steam to keep air away from the water. The floats are insulated to minimize condensation of the blanketing steam.

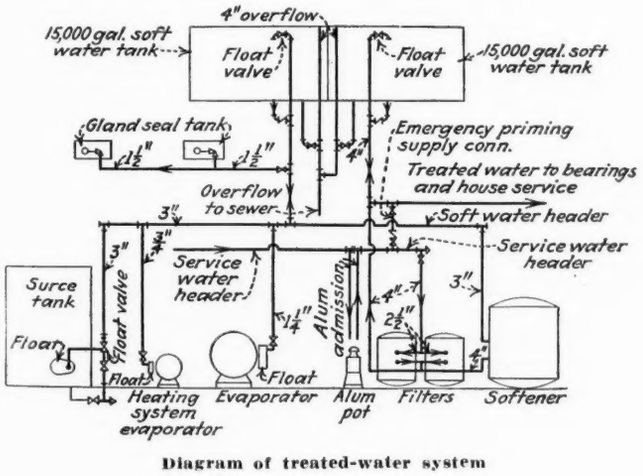


Diagram of treated-water system

Design and construction of this plant was carried out by the Byllesby Engineering & Management Corporation, of which H. W. Fuller is vice-president in charge of engineering and construction.

Turbine Repair Job Facilitated by Welding

IN INCREASING numbers power plant engineers annually overhaul most of the important equipment in their plants. Welding is becoming an important tool for this work, according to *Oxy-Acetylene Tips*.

The convenience of welding was demonstrated in the case of a repair necessary on a 300-lb. bronze turbine runner. The machine, about 20 years old, was obsolete and no replacement parts were obtainable. A new casting might have been made, but the prohibitive cost of a pattern made this impracticable.

The friction of the water, which sometimes carried particles of sand, had worn off the tips of several of the blades and had pitted others badly. A welding engineer studied the work and suggested that the blades be built up with manganese bronze welding rod.

To do this, a temporary preheating furnace was built of firebrick and asbestos paper. The casting was heated for four hours with city gas. When it was blue-black in color the welding was started. In two hours the welding was finished.

An Object Lesson From Battersea

What this latest English station is doing toward the elimination of flue dust, smoke and sulphur

IN THIS day when interest of the public in smoke prevention and the elimination of atmospheric pollution is so rapidly increasing, the producers of power should recognize the delicacy of their position.

Some do. Others are inclined to await developments. Any such policy as this simply invites trouble, since it leaves the door open for the social demagogue and the ballyhoo politician to make popular mincemeat of the power producer's good intentions. Should this happen, it will be far more difficult for the power man than if he recognizes now and prepares for the day when his traducer may strive to place him on the block.

The story of the trials of the London Power Company, in securing permission to erect its Battersea station on the Thames River, is a case in point.

It is understood that the first permits for this plant were rescinded after a vigorous newspaper and popular campaign called attention to the threatened nuisance and destruction to property from the discharging of the fumes of combustion.

Eventually, after much discussion of the pros and cons, the reissue was legally consented to, but subject to the following conditions:

"The company shall, in the construction and use of the said generating station, take the best known precautions for the due consumption of smoke and for preventing as fas as reasonably practicable the evolution of oxides of sulphur, and generally for preventing any nuisance arising from the generating station or from any operations thereat."

To meet these requirements the London Power Company has called upon the foremost experts and spared no expense in research and investigation.

The approach and the plan as finally adopted was reported in a paper by Dr. S. L. Pearce before the Second World Power Conference, from which the following digest is taken.—EDITOR.

FIRST CAME a study of the importance of various forms of atmospheric pollution from power house stacks and the effectiveness of various systems of eliminating dust and sulphur oxides Although most of the dust is widely diffused by air currents, especially in the case of tall buildings, there will nevertheless be an area around the station over which the ash fall will be noticeable, and this area will expand with the coal consumption unless adequate remedial measures are taken.

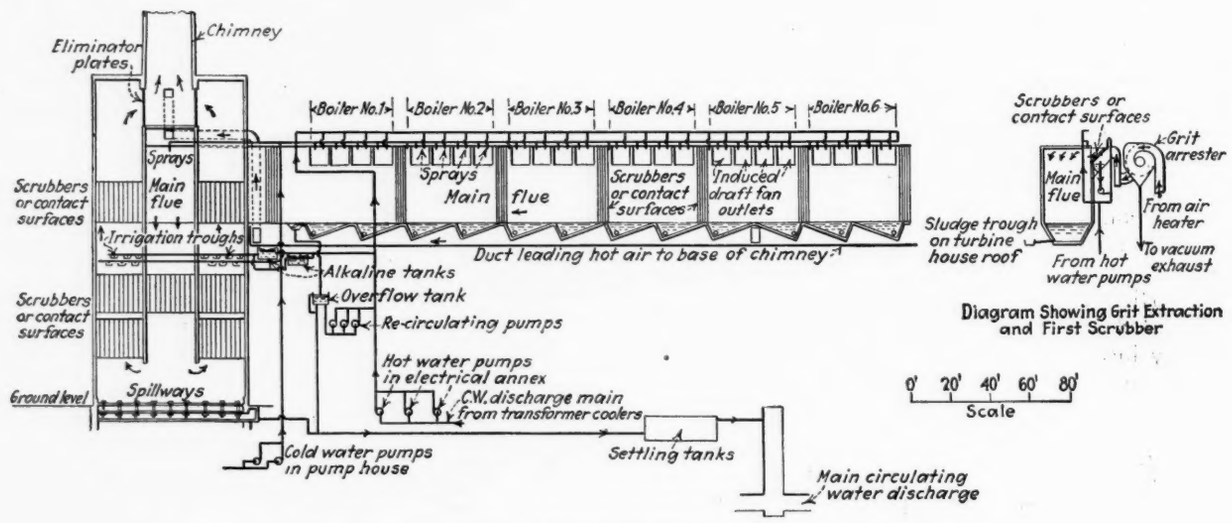


Diagram Showing Grit Extraction and First Scrubber

Diagrammatic layout of flue-gas treatment plant for the Battersea power station, London

Pollution from sulphur oxides is of quite a different character. It appears that of the total consumption of coal in London not more than 2 per cent of the sulphur burned reaches the ground level in the form of sulphuric acid. Even so, it must be admitted that a station burning daily 1,000 tons of coal containing 1 per cent of combustible sulphur will send out each day the equivalent of

20 tons of sulphurous acid, or 30 tons of sulphuric acid—an undesirable addition to the atmosphere.

An experimental plant was therefore set up at the Grove Road power station of the company on a scale sufficiently large for testing out the practicability of removing sulphur gases by washing with hot or cold water and at the same time subjecting the gases to a certain amount of scrubbing action to remove dust particles.

The experimental plant consists, essentially, of a cylindrical absorption tower 27 ft. high and 40 in. in diameter, with attachments for the delivery of flue gas and water in counter flow. For the more important series of experiments the water was delivered to three spirals, each carrying about forty nozzle sprays. These spirals were placed at heights within the tower of about 10, 17, and 24 ft. respectively.

After expensive experimentation with this outfit data were obtained leading to the following general conclusions:

1. The process must be thought of in two phases, conversion of SO_2 to SO_3, followed by elimination of SO_3 and residual SO_2.

2. While the dust in the gas acts as a powerful catalyst, there is not a sufficient quantity to affect the whole of the gas in the period of treatment, and as a very large proportion of the dust is eliminated in the early stages there is a diminishing quantity in contact with the gas to effect conversion of SO_2 to SO_3.

3. Iron in the form of oxides must be present at all stages, from the first contact of gas and water to the final elimination from the gas and in the effluent. For this purpose it appears necessary to utilize iron or steel metal surfaces which become oxidized in the gas stream, and so adapted to the work to be performed.

4. For intimate contact of gas and water, it is necessary to have:

(*a*) Fine sprays of water, and

(*b*) Wetted surfaces to break up stream lines, and to assist the conversion of SO_2 to SO_3. These surfaces must not be of a reducing nature.

5. Hot water is preferable to cold water, for conversion of SO_2 to SO_3 and for retaining the temperature of the gas.

6. There is a critical time of contact between gas and water, under each set of physical conditions, below which it is not advisable to work. These physical conditions include:

(*a*) Direction of flow of gas and water.

(*b*) Speed of gas travel.

(*c*) Amount and disposition of wetted iron surfaces.

(*d*) Amount and disposition of other wetted surfaces.

(*e*) Temperature of gas and water.

(*f*) The degree of alkalinity of the water.

7. There would appear to be a critical temperature of the gas for conversion of SO_2 to SO_3, depending upon conditions similar to those enumerated above.

8. On the basis of the foregoing conclusions it would appear that the three essentials to success for flue-gas treatment are:

(*a*) The placing of sprays along the first flue to increase the humidity of the gases, with iron surfaces to assist in the conversion of SO_2 to SO_3.

(*b*) The provision of further sprays and wetted contact surfaces in the second flue to continue the conversion of SO_2 to SO_3, and to effect the solution of the latter and their elimination from the gases.

(*c*) The provision of further surfaces wetted with alkaline water for final and total elimination of sulphur from the gas, which may or may not be necessary.

With a view to trying out these conclusions, and to determine the best velocities, quantities and proportions of parts, a full-sized gas-washing plant was installed at the Grove Road power station. For the particular conditions of this plant it appeared that there is a definite limit to the quantity of "contact" material that can be of effective use, beyond which limit no sensible improvement in the final "elimination" results is observable merely by adding more "contact" surface.

With a gas velocity of approximately 3 ft. per second, a time of contact of 12 sec., and using some 20 tons of cold water per ton of coal, an elimination of 95 to 97 per cent has been consistently maintained. Of this total some 70 per cent was effected in the horizontal portion of the washer and the remainder in the tower section, using a 10 per cent alkaline wash.

After this preliminary work, a tentative design was prepared for the Battersea power station. This plant, which is shown diagrammatically here, would appear to fulfil the following requirements regarded as essential to success:

(*a*) A low velocity for the gases.

(*b*) Initial humidification of the gases by means of atomizers or sprays.

(*c*) The provision of wetted surfaces of iron or steel to assist in the conversion of SO_2 to SO_3.

(*d*) Complete washing of the gases to remove acidulated water.

(*e*) The further provision of surfaces wetted with cold and alkaline water for the final and total elimination of sulphur from the gas.

(*f*) Ample time of contact between the flue gases and the wash-water.

(*g*) The change in direction in the path of the gases.

(*h*) Admission of hot dry air at the base of the chimney proper to mingle with the super-saturated gases with a view to avoiding condensation in cold weather.

(*i*) Provision for the introduction of suitable catalysts into the spray and wash waters as may be found desirable.

(*j*) Provision of suitable linings for the chambers through which the gases pass.

(*k*) Recirculation of the spray and wash water or other liquid, if found desirable.

(*l*) Means for the removal of sludge or other deposits.

(*m*) Means for the replacement of materials that may be subjected to wasting.

(*n*) Complete oxidation of the effluent if found necessary.

The selection of suitable materials for the construction of the gas chambers, flues, chimneys and scrubbers has involved much investigation and experiment. Accrington acid-resisting bricks appear to be fully resistant to chemical action. Staffordshire blue bricks would probably give equally good results.

Owing to the action of sulphuric acid on lime it is

necessary to exclude mortar containing Portland cement or lime, and the practical results obtained appear to show that the best acidproof compound for jointing is "prodorite" laid as a full joint and not as face pointing. *Ciment fondu* has also been found to give fairly satisfactory results.

It is the present intention to use for brickwork construction generally an Accrington brick facework set in prodorite with a similar backing set in *ciment fondu* mortar, which should give the impermeability required.

A considerable amount of inquiry and investigation has been made into the resistance to corrosion of most of the ordinary metals, as well as the special corrosion-resisting steels. Mild steel is out of the question, and it is considered that the newer form of cupreous steel would give unsatisfactory results when exposed to the conditions of temperature, scour and corrosion expected to obtain. Difficulty also exists in manufacturing the sections that would be required in the special steels.

Where structural steel is required it is intended that it shall be kept well away from the points of corrosion, and when incased in brickwork will receive protection on its surface by a heavy coating of special paint or by lead spraying, the work in all cases being further protected by a *ciment fondu* concrete casing.

The roof of the main horizontal flue will be built up of readily replaceable cast-iron plates attached to the supporting members of the structural steelwork, provision being made for expansion.

Where, for chemical reasons, it has been found necessary to provide a predetermined amount of scrubbing or contact surface in iron, the use of corrugated sheet plates is favored, of varying thicknesses and of suitable sections to facilitate replacements.

Care is necessary in determining the contours and arrangement of the surfaces to give correct spacing, maximum scrubbing effect and minimum pressure losses.

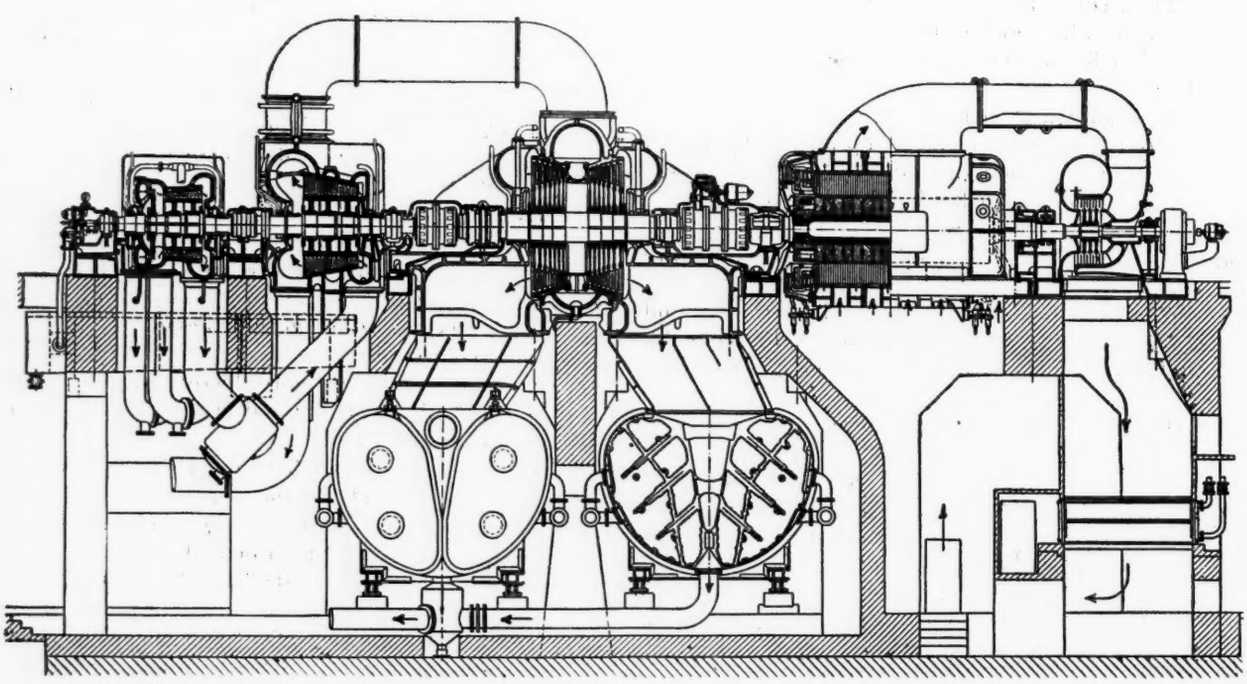
In the last stages of the gas treatment suitable timbers may be used instead of iron to provide the necessary contact surface.

As regards the neutralization of the wash water, this will be effected by mixture with the "condenser" water drawn from the River Thames, the volume of which will be about 40 times that of the wash water. The alkalinity of the Thames water (expressed as $CaCO_3$) is of the order of 20.0 parts per 100,000.

The only alteration in the character of the river water would be a slight diminution in the carbonate content and a corresponding increase in the amount of sulphate present. To remove suspended matter and to oxidize any sulphites that may occasionally be present, provision will be made for settling tanks of adequate capacity.

▼ ▼ ▼

High-Efficiency Turbine Installed at Zschornewitz



The Aug. 5 number of *Power* reported the high efficiency of 87.7 per cent obtained during acceptance tests on the 85,000-kw. turbine recently installed in the Zschornewitz plant of the Electrowerke A.-G., Berlin, Germany. Above is a cross-section of this unit, which was described as a two-cylinder instead of a three-cylinder unit. The turbine is designed to operate with steam at 14.5 atmospheres (206 lb. per square inch) and 360 deg. C. (630 deg. F)

Waterville (Ohio) Installs Diesels To Meet Industrial Load

WATERVILLE, OHIO, with a population of approximately 900 people, is located on the Maumee River within a few miles of Toledo. With a 100-kw. demand it had been able to buy power at wholesale at an average cost of 1.8c. per kw.-hr. and resell it at an average price of 3.68c. which was sufficient to cover operating costs and allow the accumulation of a substantial surplus.

Early this year, however, a large industrial concern agreed to locate in Waterville and have its plant in operation by the first of April, provided the village board would guarantee an adequate dependable power supply. To this the board agreed, but the normal demand had grown to 120-kw., which in itself was greater than the contract rating, so that a new high-tension line and substation would have to be built before the additional new load of 150-kw. could be accommodated. This meant a new and, as it developed, a much less favorable contract for the village. As an alternative the village board met with representatives of a diesel engine manufacturer for a discussion of the problem. On Jan. 15 a complete plan covering engineering details, estimates of cost, finance and legislation involving a new municipal light and power plant was presented and accepted by the board. By Feb. 15 bids had been received and work was started the next day. The engines were on their foundations before the walls of the building were up, and the first unit was ready on April 1, as agreed. The other machines were soon installed, and the entire plant was in working order by May 1, just 75 days after the award of the contract and only 105 days after the decision had been reached to build a plant. Minor details, cleaning up and other items delayed final inspection and acceptance until May 10.

Since April 10 the plant has been furnishing power for the new industry whenever needed. The village itself, however, continued to use outside power, because of its obligation to the power company. Upon the expiration of the existing contract, on Sept. 10, the entire load was placed on the new plant. The total capacity of the plant is 540 hp., divided into three units of 120, 180 and 240 hp., respectively, all with direct-connected alternators and exciters.

Exterior of plant, showing storage tank, cooling tower and water-washed stack

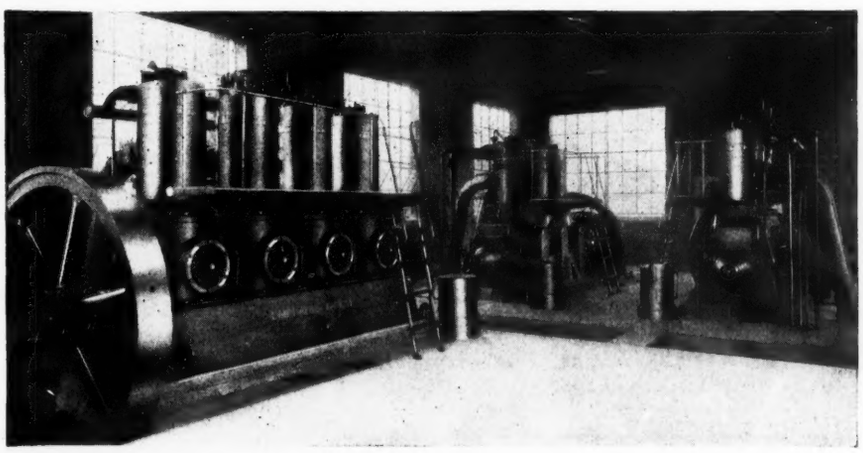
Exhaust gases are carried away by underground conduits and outside water-washed stacks. The exhaust temperature of any cylinder of any engine can be checked by pyrometers grouped on a centrally located panel.

The cooling system is of the closed type, in which only soft, treated water comes into contact with the engines. The soft water flows from a cypress tank on a 30-ft. steel tower to the engines and then into a steel hotwell just outside the building. A 3-in. motor-driven pump in a pit adjacent to the hotwell, but inside of the building, forces the hot water through a shell-and-tube heat exchanger and back again to the elevated storage tank. Raw water for use in the heat exchanger is also circulated by means of a 3-in. pump in the same pit. The raw water is cooled after it leaves the heat exchanger in a standard wood tower mounted above a concrete storage basin from which the pump takes its suction.

A third pump, identical with the first two, is available for use in either the soft- or raw-water system. An alarm system is arranged to warn the operator should the water get low in the storage tanks or the power supply to the pump motors fail.

Air starting equipment also is in duplicate. It consists of a two-stage air compressor direct connected to a 3-hp. engine and a second machine close-belted to a 3-hp. motor, with the usual complement of air tanks and fittings.

A separate small fuel oil service tank is provided for each engine, and these, in turn, are filled from a large storage tank, all fuel oil being metered as it flows from the storage tank to the service tanks.



Fairbanks-Morse units of 240, 180 and 120 hp. are installed

Predicting the BEHAVIOR of a BABBITT

By A. HOYT LEVY
United American Metals Corporation

Of all the materials used in machine construction, less seems to be known about bearing metals than about any other. This should not unduly grieve the operating engineer, for many designers are as much at sea. The author of this article explains what tests are suitable and what are worthless

IT IS a curious fact that many engineers, when considering the selection of a babbitt for a specific purpose, attach more importance to Brinell hardness than to any of its other properties. Some of them even order their babbitt simply by specifying a Brinell hardness number. Yet the Brinell hardness is of little real value in estimating how well a babbitt will stand up against shock, load and speed. In fact, Brinell hardness of a babbitt, as taken, is rarely accurate, the number being arrived at by taking an average of two measurements from different parts of the specimen. As a single point is quite considerable in the Brinell hardness of a babbitt and as the two numbers from which the average is taken are frequently as much as four points apart, the final figure cannot be accepted as a true basis upon which to judge the hardness of the metal. This is particularly pertinent for the reason that babbitt hardness numbers range only between 18 and 34.

To determine the Brinell hardness of a babbitt, a steel ball 10 mm. in diameter is pressed into a smoothed surface of the metal by a 500-kg. load for a period of 30 sec., with the babbitt temperature held at 65 deg. F. The diameter and depth of the impression made by the steel ball is measured and the Brinell hardness number taken as the quotient of the applied load divided by the area of the surface of the impression.

The point of emphasis is that the hardness of a babbitt is not a measure of its ability to withstand the shock or load under which a bearing operates in service. The only questions that require answer when determining the value of a babbitt for a specific operating service are: Will it stand the shock; will it carry the load; will it keep cool under the speed? The Brinell hardness number does not answer any of these questions with any kind of accuracy.

While a Brinell test may be important in testing steel, iron, aluminum and other hard metals, its value in babbitt lies only in that it permits of what might be termed as a "quick guess" of the babbitt's strength in the absence of results from compression and tension tests. It is of much the same value as the "button test" used by babbitt manufacturers in quickly computing the probable composition of the metal in the absence of chemical analysis. Even then, only one with an intimate metallurgical knowledge as applied to babbitt will find the Brinell and button methods of any practical value.

The most important factor in determining the ability of a babbitt for a specific bearing purpose is its measure of resistance to pounding. Of second importance is its measure of resistance to pressure. Almost invariably a babbitt that can resist heavy pounding will resist heavy pressure, although a babbitt may be able to carry a heavy pressure and yet be unable to withstand pound. Of third importance is its measure of resistance to friction. There are, of course, a number of other factors that should be considered, but they are of comparatively minor importance.

The measure of resistance to pounding and pressure can be determined only by tension and compression tests. The former is a measure of babbitt's ability to withstand the pull or strain on the lining caused by the load it carries. The latter measures its ability to carry the load without distortion.

Both of the above tests are expensive compared to Brinell tests. There are so many babbitt formulas extant that it is hardly feasible to have these tests made of all formulas, especially as so many of them have no reason for existence. There really need be no more than five formulas to cover practically every babbitt requirement, yet the A.S.T.M. recognizes thirteen, and those do not represent half the number that manufacturers are asked to make. It is needless to say that many of them are obsolete compositions that originated back in the early days of engineering; once in the records, apparently no one knew enough or cared enough to change the formula to one more suited to modern needs.

To explain the value of compression and tension tests and how they are carried out, I shall take the wrist-pin bearing of a diesel engine, which, at its highest, would

be subjected to a pressure of 1,750 lb. per square inch. On ordinary bearings, 2 is taken as a factor of safety, but where shock is present, as in the bearings of a diesel engine, the factor of safety is 4. The babbitt selected should therefore be able to carry a working load of 1,750 × 4 = 7,000 lb. per square inch.

To determine the working load of a babbitt by compression test, a cylindrical specimen 2.50 in. long x 1.25 in. diameter is used. To this specimen a load of 500 lb. is applied and its compression is measured. The load is increased by increments of 500 lb., and the compression of the specimen is measured with each increase. This is continued until a permanent set indicates the first actual deformation, which is taken as the yield point. The pressure applied at this time, divided by the original area, is the actual stress in pounds that the babbitt is capable of carrying without deformation.

To determine a babbitt's tensility, a similar specimen is taken and subjected to strain or pull. The strains are measured at increments of about 250 lb., until the original area shows permanent deformation. The stress applied at this point is taken as the load that the babbitt can withstand when subjected to strain or pull.

In both the tension and compression tests the loads are usually continued until the babbitt fractures or undergoes a plastic flow. The load applied at the time the babbitt fractures indicates the ultimate strength of the metal. The figures, however, beyond the point of deformation in the tension test and the yield point in the compression test should not be given more than passing consideration in determining the capability of a babbitt.

"The only questions that require answer when determining the value of a babbitt for a specific operating service are: Will it stand the shock; will it carry the load; will it keep cool under the speed? The Brinell hardness number does not answer any of these questions with any kind of accuracy"

The coefficient of friction was given as of third importance in the consideration of a babbitt because the very principle of Isaac Babbitt's invention was in the use of a lining metal with a low coefficient of friction. All babbitts are therefore more or less of an antifrictional nature. However, the relative ability of a babbitt to withstand friction can be determined with sufficient accuracy by a knowledge of the metal's character. A lead-base babbitt has a lower coefficient of friction than a tin-base babbitt. It may be taken as a general rule that, in a tin-base babbitt where the copper content is above 4 per cent or the antimony content is above 9 per cent and the babbitt contains no lead, the tendency is toward a relatively high coefficient of friction. A babbitt containing 8 per cent or more of lead is generally cool-running.

Reverting again to Brinell hardness, the Brinell number taken in a test of a babbitt specimen is lower than that of the babbitt after it is lined in the shell. This is particularly evident where the lining is thin, as the Brinell hardness of the babbitt in the shell depends upon the thickness of the lining; so here again the hardness number of the babbitt specimen does not reflect the hardness of the babbitt when in service.

Any lead-base babbitt can be made harder by increasing the antimony content. To make a tin-base babbitt harder it is only necessary to increase the percentage of the antimony or the copper, or both, necessitating, of course, a reduction in the tin content. But it should be understood that increasing the antimony and the copper contents beyond a given point tends toward brittleness, making the lining liable to crack, and also increases its coefficient of friction to a hazard where the bearing is operating at a high r.p.m. While the additional hardness may add strength to the babbitt, the chances are that the babbitt, if it is of a well-balanced formula, already has a strength in excess of its needs.

Safety Switches

By MARIN PHILLIPS

Electrical Supt. International Paper Co.
Niagara Falls, N. Y.

SAFETY SWITCHES are so named because they have their current-carrying parts inclosed in a metal cabinet. This cabinet allows the switch to be opened and closed with an external handle.

The fact that they are called safety switches does not mean that they are immune from causing accidents. On the other hand, they offer serious hazards if certain precautions are not taken when dealing with them.

The switch blades are attached to a metal cross bar and insulated from it with thin insulating tubes.

Short circuiting of the switch blades is the most serious hazard that we have to contend with. This may be caused by the insulating tubes breaking down, which allows the cross bar to come in contact with the switch blades. These insulating tubes are only about 1/16 in. in thickness and will not stand much abuse. It is for this reason that a safety switch should never be forced open or closed. To do this may cut through the insulating tubes and short circuit the switch.

Sometimes a safety switch will be found stuck tight in the closed position, due to heat or corrosion, making it hard to open. If a switch will not open or close without using undue force on the handle, do not operate it. If it is in the closed position, shut the power off and work the switch open carefully, and get it to working freely before putting the power on again.

The necessity of taking these precautions is best explained by relating the following accident. It was desired to inspect a compensator, and the safety switch was found to be stuck tightly closed. No amount of pulling on the handle would open it. To apply more force, a rope was placed around the cross-bar and three workmen pulled on the rope, with the result that the switch blades were short circuited. Two men were so badly burned that they were kept away from their work for about two months.

To inspect a compensator or oil switch, first make sure that it is in the off position. Then with the switch cover closed, open the switch; then open the cover and make sure that one blade has not stuck in the closed position. Also see that one blade has not been wired around, which sometimes happens when a connection goes bad.

A Comparsion of PULVERIZED COAL and STOKERS in Industrial Plants

By SAMUEL M. GREEN
Consulting Engineer
Springfield, Mass.

Public-service plants have to meet essentially the same requirements, and they vary principally in size. Industrial plants, however, must meet widely different conditions, not only in the many different industries but also within one industry. This paper relates to boilers and their auxiliary equipment as applied to industrial uses only and includes actual installation costs and manufacturer's performance guarantees in two comparative plants, one with stokers and the other with pulverizers.

WHEN an engineer is called upon to design an industrial steam generating plant, practically the first question asked by the owner is: "Do you advocate the use of pulverized coal or automatic stokers?" If the engineer expresses a strong preference for one or the other, then the next question is: "Why?" And unless he is thoroughly familiar with the conditions of the particular plant, and especially the personal preferences he will have his job cut out for him then and there.

I designed and supervised the installation of two boilers in 1927 of the same size, make and operating pressure—one equipped with automatic stoker and one with coal pulverizers. One was installed for Joseph Bancroft & Sons Company, Wilmington, Del., textile bleachers, dyers and finishers; and one for the Fitchburg Paper Company, Fitchburg, Mass., makers of book papers. Recently I designed and am supervising the installation of practically a duplication of this equipment for the same companies. A comparison of the cost of the last installations and the reasons for use of stokers in one instance and coal pulverizers in the other may be of interest.

In setting up the comparison of cost, I have not in all cases used the actual equipment installed at each plant, as that would not give an exact cost comparison; for instance, the boiler used at Wilmington was a Bigelow-Hornsby and at Fitchburg a Bigelow-Connelly. I have used the cost of the Bigelow-Connelly boiler in both cases, thus eliminating any variation in cost of the boiler proper. Likewise, apparatus that was installed in one plant and not in the other has been omitted, such as economizers, flues (not common to both), etc. Piping has been included, as its cost was practically the same in both instances. Ash, coal-conveying and bunker equipment are not included, as such equipment depends upon local conditions.

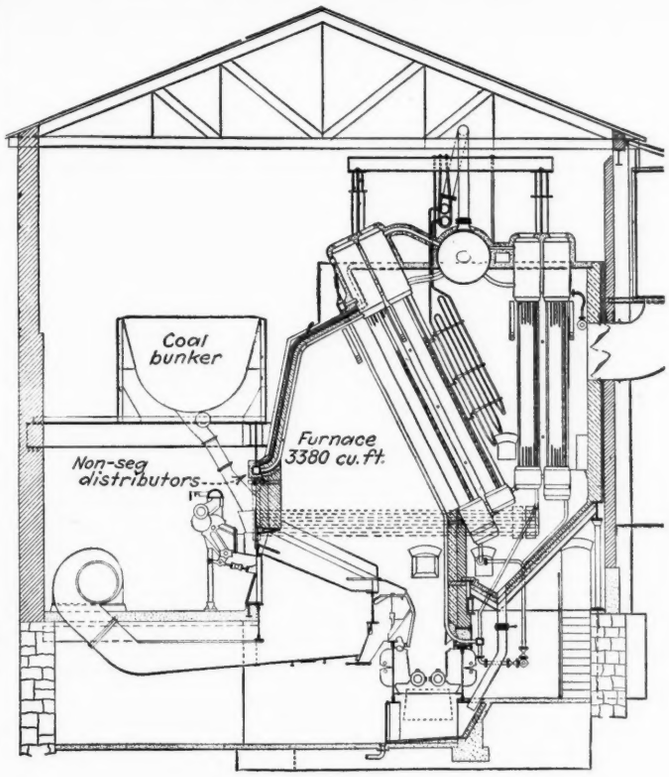
COMPARISON OF COST

	No. 1 Bancroft	No. 2 Fitchburg
Excavation	$1,300	$1,300
Concrete reinforced foundation below grade	600	600
Concrete setting walls above grade	2,580	....
Concrete floors basement and boiler room	1,200	1,200
Boiler delivered and erected, including slag screen, rear wall protection and front water wall	20,500	20,500
Drake armor-clad for rear wall water tubes	1,700	....
Ash pit doors	200	380
Supporting steel for boiler and air cooled walls	4,050	6,050
Superheater	5,000	5,000
Air-cooled wall refractory and brackets	2,100	4,200
Boiler setting including all refractories except air-cooled wall	8,400	9,300
Stoker: 29 tuyeres, 10 retorts, double 14-in. crusher rolls; projected area 240.8 sq.ft.; steam turbine stoker drive direct-connected; crusher rolls driven by hydraulic motor; overspeed governor	18,800	....
Non-Seg coal distributors, 3	1,500	....
Pulverized coal equipment: 2 pulverizers, 6,000 lb. per hr. each; 2 low-pressure coal burners; coal piping from pulverizers to burners; motors direct-connected to pulverizers	....	14,250
Soot blowers	2,000	2,000
Instruments: steam-flow meter, CO2 meter, multi-pointer draft gage, flue-gas temperature recorders	1,600	1,600
Combustion control	1,100	1,400
Liquid-level gage	190	190
Soot-pit gates and metal hoppers	900	900
Steam purifier and deconcentrator	950	950
Feed-water regulator	190	190
Piping and insulation	5,000	5,000
Platforms and stairs	1,500	1,500
Blast fan, turbine-driven, 35,000 c.f.m., 6-in w.g.	3,300	3,300
Flue	2,450	2,450
Blast-duct work, including return air from air-cooled walls	....	1,100
Blast-duct work, not including return air from air-cooled walls	1,800	....
Total	$88,910	$83,360
Induced-draft fan, 47,000 c.f.m., 65 b.hp., motor driven		$2,600
Steel supports		600
Economizer		11,500
Extra flue		600
Total		$15,300

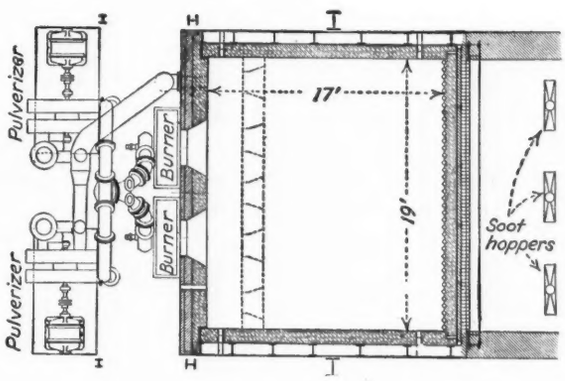
The economizer and necessary fan increase the guaranteed efficiency at 200% of rating from 78% to 83.6%, and this shows a gross saving of about $8,000 per year.

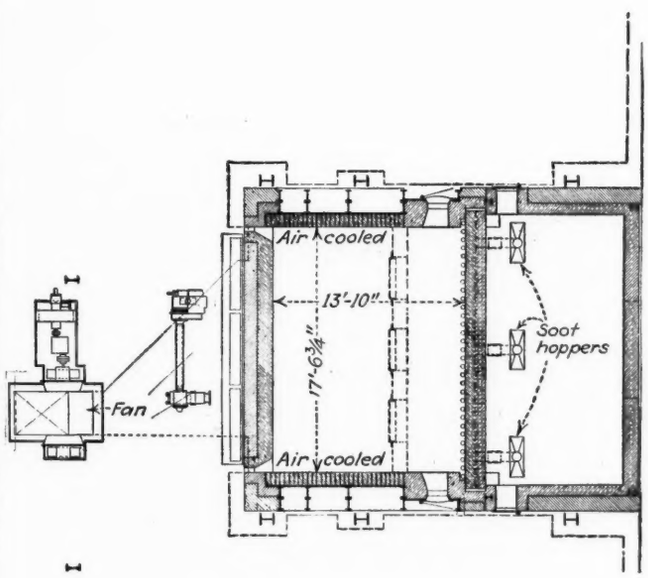
An explanation of certain items included in the cost of installation follows. Reference is made to the estimates by column numbers.

Column 1 lists a concrete foundation and concrete setting wall, Column 2 a concrete foundation only. This is because in an automatic stoker setting the walls below the stoker line carry the weight of the stoker and are not of refractory material, whereas in a setting for burning pulverized coal the refractory goes to the basement grade, providing the larger furnace necessary for pulverized coal. This is also why the steel and air-cooled

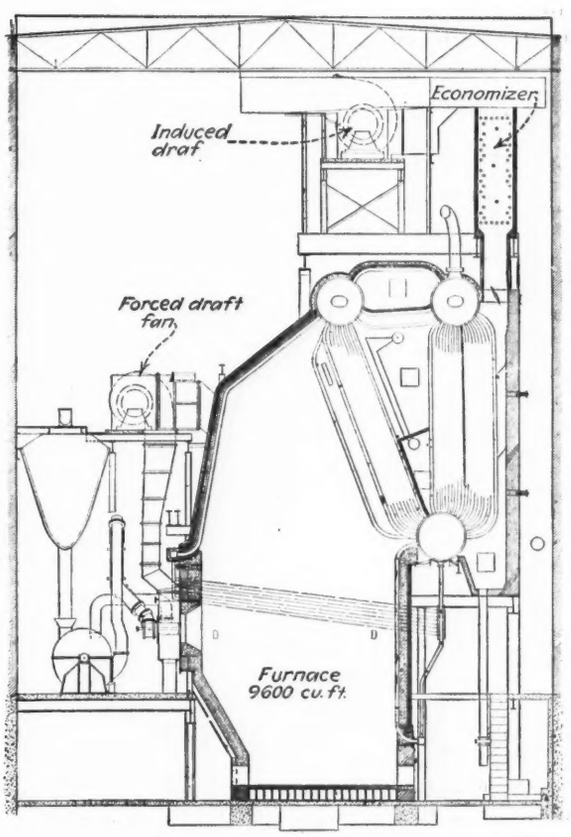


Below — Pulverized-coal fired boiler setting at Fitchburg Paper Company





Above—Stoker-fired boiler setting at Joseph Bancroft & Sons Company



Data on Equipment Installed in the Two Plants

JOSEPH BANCROFT & SONS COMPANY

Details of Installation

Boilers, 1,013-hp. Bigelow-Hornsby, 250 lb. working pressure	The Bigelow Co.
Slag screen and rear water-wall combined	
Front water-wall	
Rear water-wall equipped with Drake armor-clad protection	
	Sq.Ft.
Heating surface boiler	10,126
Tube surface front water-wall	479
Tube surface in slag screen	530
Tube surface in bridge wall	340
Furnace with air-cooled side walls	Bigelow-Liptak Corp.
Superheater, 125 deg.	The Superheater Co.
Stoker, 29-tuyere, driven by direct-connected steam turbine; 14-in clinker crusher roll driven by motor-driven hydraulic pump and motor, 240.8 sq.ft. projected area	American Engineering Co.
Soot blower	Diamond Power Specialty Corp.
Blast fan, driven by Terry steam turbine through reduction gears; capacity 35,000 c.f.m. 6-in. w.g.	Fan—B. F. Sturtevant Co. Turbine—Terry Steam Turbine Co.
Induced draft-fan—None	
Combustion control	Hagan Corp.
Non-Seg coal distributors	Rolland Gardner & Co.
Blast ducts, smoke flue and piping—installation by	B. F. Shaw Co.
Insulation	B. F. Shaw Co.
Boiler setting	Rust Engineering Co.

Hot-air flues from the top of the air-cooled wall to the blast fan have not as yet been installed. A test will be made to see if their cost is warranted. An economizer or air preheater was not installed because either installation would have required extensive building changes and the cost was not warranted by saving to be effected.

FITCHBURG PAPER COMPANY

Details of Installation

Boiler, 1,083-hp. Bigelow-Connelly, 250 lb. working pressure	The Bigelow Company
Slag screen	
Rear water-wall and front water-wall	Sq.Ft.
Heating surface, boiler	10,830
Heating surface, rear and front wall	1,408
Total	12,238
Furnace, air-cooled side walls and front water-wall below burners; design, bottom air cooled	Bigelow-Liptak Corp.
Superheater, 150 deg. F.	Foster Wheeler Corp.
Economizer, 5,184 sq.ft.	Foster Wheeler Corp.
Pulverizers, 2, with two burners; capacity, 6,000 lb. coal per hour each; driven by 2 50-hp. motors directly connected	Riley Stoker Corp.
Soot blowers	Diamond Power Specialty Corp
Blast fan, capacity 35,000 c.f.m.; driven by 25-hp., four-speed Reliance motor	Buffalo Forge Co.
Induced-draft fan, capacity 47,000 c.f.m.; driven by 75-hp. three-speed, Reliance motor	Buffalo Forge Co.
Combustion control	A. W. Cash Co.
Blast ducts, smoke flue, piping and insulation by	The Jennison Co.
Boiler setting by	Rust Engineering Co.

The Riley Stoker Corporation guarantees to operate the boiler at 300 per cent rating without slagging in the furnace. About 90 per cent of the air required for combustion is drawn by the blast fan through the bottom of the furnace and side walls and is delivered to the burners. The air required for carrying the coal through the pulverizers and into the furnace is drawn from the furnace and is mixed with air from the boiler room to reduce its temperature to about 300 deg. F. This heated air helps to maintain a low moisture content in the coal.

wall refractories cost less in Column 1 than in Column 2.

In Column 1 Non-seg distributors are included, as they are necessary to maintain an even fire on the stoker.

Each of these boilers will usually operate at about 200 per cent rating. The pulverizers are in duplicate, and either will operate the boiler to 200 per cent rating with coal having not more than 5 per cent moisture. Either pulverizer can be repaired while the other is operating. In this plant, this duplication is of great advantage. An accident to a stoker would shut the boiler down and the setting would have to cool before repairs could be made. In comparing the cost of installation, this duplication should be taken into account.

The Bancroft Company installed stokers for the following reasons:

1. Their boiler plant used stokers previous to the last two installations.

2. The owners live in a large park on a pleateau about 100 ft. above the plant and adjacent thereto. They feared that the fine ash which is discharged from a chimney when pulverized coal is used would cause trouble in their neighborhood.

3. The ash from this boiler plant is removed by the railroad without cost, as it is used for filling. The railroad would not continue this free service if ash from the pulverized coal had to be removed, because it could not be used for fill.

The Fitchburg Paper Company installed pulverizing equipment for the following reasons:

1. They had some years ago an unfortunate experience with stokers. I do not know whether this was due to improper equipment or installation, or both. They then installed an equipment for burning pulverized coal under three horizontal return-tubular boilers. It was only fairly successful.

2. When the owners decided to install new boilers, extended investigations were made by their plant engineer, E. B. Wright, and myself, and upon the result of these investigations the owners decided to use pulverized coal. The first boiler and setting were designed for operation at 200 per cent rating. The setting for the second boiler is designed for 300 per cent operation.

3. Although, as is usual when pulverized coal is burned, a very large proportion of ash goes up the stack, the plant is in open country and no complaint has been made.

I believe that at the present time either system may be installed without fear of making a grave mistake, assuming that the apparatus is properly designed and installed to meet the particular plant conditions.

The cost of installing either system is shown to be approximately the same, although the pulverizing equipment is nearly in duplicate.

The stoker manufacturer guarantees better operating efficiency than the manufacturer of the pulverized-coal equipment. My experience indicates that either system with careful supervision will give about the same efficiency, although it is more difficult to maintain a uniformly high efficiency with stokers because of the manual labor involved in their operation.

The excess power required to operate the pulverizing equipment over stokers is about 26 kw. when the boilers

STOKER EFFICIENCY GUARANTEES

Boiler rating, B. Hp.	Flue gas temperature, Deg. F.	Efficiency, Per Cent
1,000	490	82
2,000	577	80.25
3,000	700	76.5

Air required at 70 Deg. F.

Boiler rating, Per cent	Static pressure, In.	Hp.	C.f.m.
100	1.0	2.5	9,500
200	2.4	11.7	19,300
300	4.0	33.5	30,500

Power to drive stoker and crusher rolls. When burning 6,000 lb. coal per hour, 2.5 hp.

PULVERIZED-COAL EFFICIENCY GUARANTEES:

Boiler rating, B.Hp.	Flue gas temp., Deg. F	Efficiency without economizer, Per cent	Efficiency with economizer, Per cent
1,000	490	80	84
2,000	1550	78	83
3,000	650	74	82

Horsepower required per ton of coal pulverized:

Lb. Coal per Hr.	Hp. per Ton
2,000	28.5
4,000	17.4
6,000	14.3

Fineness—Per cent passing each screen:

75	200 mesh screen
90	100 mesh screen
97	50 mesh screen

Air required 70 Deg. F.

Boiler rating Per cent	Static pressure, In.	Hp.	C.f.m.
100	1.0	2.4	10,000
200	1.25	6.4	20,000
300	1.5	14.0	30,000

are operating at 200 per cent rating. Unless power is a byproduct, this excess is an unfortunate handicap on the use of pulverized coal.

If the boilers operate less than 24 hr. per day, the loss in banking stoker-fired boilers will probably be as great as the cost of the excess power required to operate the pulverizing equipment.

If pulverized-coal-fired boilers are located in a thickly settled area, it may be necessary to eliminate the ash which is carried up the stack, amounting to about 50 per cent of the total ash. The equipment to catch this ash is somewhat expensive to install and operate.

Boilers may be operated at much lower ratings with stokers than with pulverized coal. Sometimes this is an important consideration.

The cost of ordinary repairs is about the same per ton of coal burned for each system. Extraordinary repairs are more likely to occur with stokers.

Unless careful thought is given to the design of furnaces for burning pulverized coal, difficulty may be experienced with clinkers.

I am not impressed with the statement, so often made, that any kind of coal can be burned with pulverizing equipment. Stokers will burn as wide a variety of coal as need be considered.

Operating results cannot be given at the present time; only one boiler has been started, but the other will be in operation in a few weeks. When both boilers are operating, I shall determine the operating efficiency of each and hope the results will be of interest.

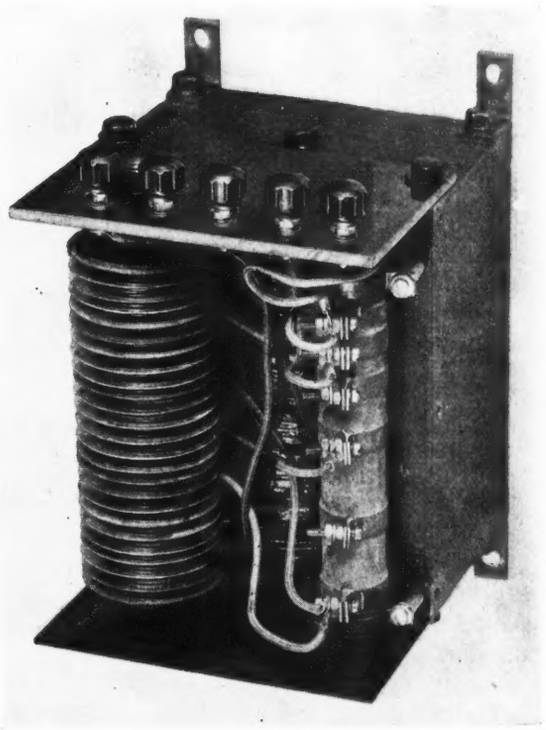
▼ ▼ ▼

D.-C. Undervoltage Relay Controls A.-C. Circuits

An inductor-type direct-current time-delay undervoltage release has been developed that is applied through a copper-oxide rectifier to protect alternating-current equipment against voltage failures

By W. M. BRAINARD

Circuit Breaker Engineering Dept.,
Westinghouse Electric & Manufacturing Co.



Undervoltage time-delay device assembly, consisting of copper-oxide rectifier and inductor, with cover removed

UNDERVOLTAGE-RELEASE devices are generally supplied to circuit breakers to cause them to open the circuit when the main voltage falls below a definite percentage of normal. There are two applications where undervoltage protection is necessary. First, where machinery being driven from the controlled circuit might injure an operator if it should start unexpectedly upon return of voltage. Such would be the case should power fail for some time and the operator not open the switch before working on the machine. The second instance is where either the motor or its driven load is not adapted to full-voltage starting or where a starting sequence is necessary.

The simple undervoltage release will function to trip its circuit breaker when the voltage failure is for only a small fraction of a second. It is usually undesirable to have a circuit opened on momentary dips in voltage, as it causes loss of time and may even damage the product being manufactured. The most efficient system of undervoltage release would be one in which each device would remain inoperative for as long a time as possible without interfering with its primary purpose. In the case of the first-mentioned application, it would be satisfactory to have the device remain inoperative for a time just sufficient for the machinery to come to rest. The second case generally takes precedence, because nearly all large motors and machines require some definite starting cycle, and they should be cut off the line if the duration of the power failure is enough to allow the machines to slow down below the speed at which full voltage may

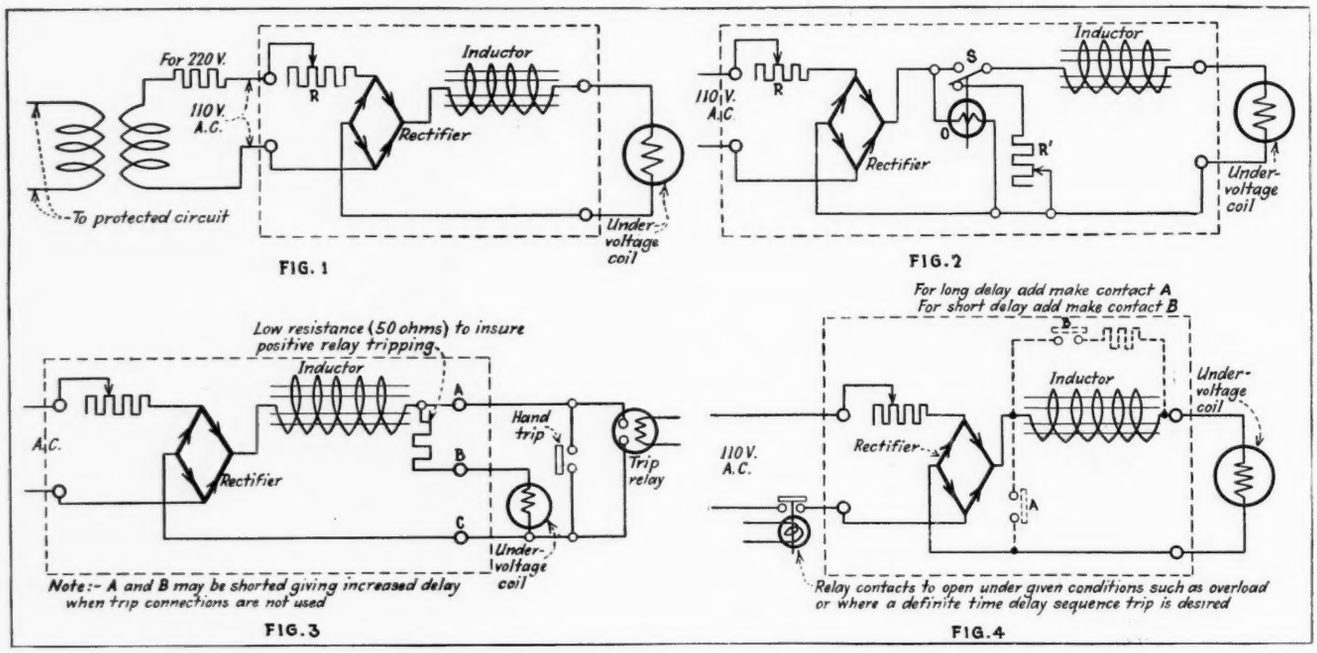
be safely applied. For such cases some form of undervoltage time delay must be applied.

An undervoltage time delay is a device which operates to prevent any undervoltage-tripping mechanism from functioning until a certain time has elapsed after voltage failure. In case the voltage returns before the end of this time, the delay device must retrieve automatically and continue to hold the release mechanism inoperative. The undervoltage release, as generally applied to circuit breakers, consists of a holding coil with its magnetic circuit so arranged that when the coil is energized the armature is held against the effort of a spring or weight. When the voltage of the controlling circuit, and thus the power of the holding coil, has dropped to a set value, the armature is released, allowing the spring or weight to trip the breaker.

A number of devices have been developed to meet these requirements, the first being the switchboard undervoltage relay which closes a pair of contacts in a set time after voltage failure. These contacts are usually in parallel with the shunt-trip switch and thus utilize power from the station battery to trip the breaker. There are, however, many applications where there is no separate source of power supply, and in such cases it is necessary that the delay and trip mechanism have the timing and tripping energy stored within themselves. Mechanical devices are made where the time delay is caused by the action of a spring operating a train of gears against a windage or escapement load. Others obtain the desired delay by means of an air bellows or oil dashpot.

The switchboard undervoltage relay is standard where a battery supply is available and the installation warrants the cost. The other devices all have serious limitations. All of them must be connected mechanically to the release on the breaker, which means that the device must be designed to mount on, and operate with, each type of breaker mechanism. Clockwork devices have the fault that, with so many small moving parts, a small amount of dirt may prevent their operation. All bellows and dashpots are easily rendered inoperative by dirt, and oil dashpots are unreliable because of the change of oil viscosity with temperature. Since these devices must be automatic retrieving on return of voltage within the set time, those that have holding coils must have them powerful enough to retrieve the armature after it has moved a distance corresponding to the full-time delay. This means either a large coil and magnetic circuit or a comparatively large power consumption.

Considerable thought has been given to development of an undervoltage time-delay device that would eliminate some or all of these objectionable characteristics. The inductor-type, as the name indicates, obtains its delayed action by the use of an inductor. It is well known that considerable energy may be stored in an inductive circuit by a direct current, and that if the source of power is removed, the circuit remaining unbroken, a current of decreasing value will continue to flow. The rate of delay of this current is determined by the ratio of the inductance to the resistance of the circuit. Thus if the holding coil is connected in series with a large inductance and a direct current is caused to flow through this circuit the holding coil will retain its armature in the closed position for some time after the power supply has been removed, provided the circuit remains unbroken. This delay is the time required for the current to decrease to the drop-out value of the holding coil. Such a device would have a limited scope, since it must be supplied with direct current—while most undervoltages are applied on alternating-current circuits—were it not for the new copper-oxide type rectifier which easily and cheaply changes the applied alternating current to direct current suitable for operating such a device. The inductance acts as a filter, smoothing out the rectifier current wave to a flat direct-current value. Although the



FIGS. 1 TO 4—APPLICATION DIAGRAMS OF INDUCTOR-TYPE TIME-DELAY DEVICE

Fig. 1—Diagram of a simple circuit for an inductor-type time delay, connected to an undervoltage release coil. Fig. 2—Same as Fig. 1, with relay *O* added to increase the undervoltage release delay time. Fig. 3—Diagram showing application of undervoltage device for protection instead of a shunt trip. Fig. 4—Undervoltage time-delay device combined with overload protection.

normal current must be many times the drop-out value to obtain an appreciable time delay, the device takes about the same or less power than a standard instantaneous device, on account of the better holding power of the direct current.

Fig. 1 is a simple circuit for the inductor-type time delay, connected to an undervoltage release device. The adjustable resistor *R* is used to reduce the 110 volts to a value suitable for a single-stack rectifier and also to give a time adjustment down to approximately 50 per cent of maximum. For 220 volts an additional resistor is connected in the circuit ahead of the adjustable one. When the alternating-current supply fails the inductor circuit is complete through the undervoltage coil and the rectifier. Since the inductance of this circuit is high compared to the resistance, the current decreases at a relatively low rate, as shown by the curves in Fig. 5.

In the event a longer time or a high drop-out value is desired a small relay may be added, as indicated in Fig. 2. In this case, when the voltage falls to the drop-out value of the relay, the rectifier load is opened and the inductor undervoltage coil circuit is completed through the relay contacts with or without an adjustable resistor *R'* in series. In Fig. 2, *S* indicates the single-pole, double-throw relay contacts and *O* the operating coil of the relay. This eliminates the rectifier resistance from the direct-current circuit and thus nearly doubles the maximum time delay, as shown in Fig. 5. The top curve shows the time delay with relay *O*, and the bottom curve the delay when the relay is not used. Relay *O* may be set to drop out at a high percentage of normal voltage, thus giving true undervoltage protection, although this is seldom required in cases where this type of undervoltage protection would be applied. The big advantage of relay *O* is that it doubles the time delay without increasing the size of the device. Since the relay may be the small type used in telephone and supervisory control service, it may be mounted inside the same case as the rectifier.

This type of undervoltage time delay is adaptable to many tripping schemes, as indicated in Figs. 3 and 4. Fig. 3 shows a standard application using the undervoltage device for complete protection in place of a shunt trip. In certain sequence operations or where definite time-delay overload protection is desired other relays may be connected to open the alternating-current circuit

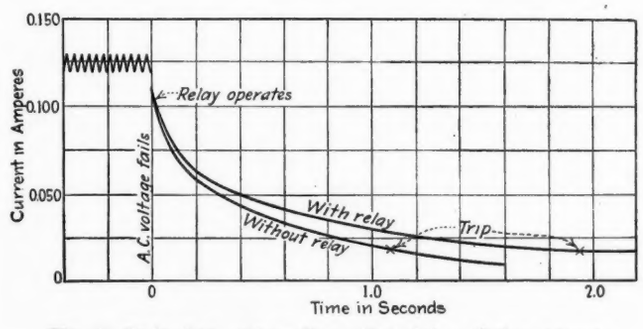


Fig. 5—Induction undervoltage time-delay timing curves

under predetermined conditions and thus trip the breaker after the regular undervoltage time delay or any fraction of it. Such a connection is indicated in Fig. 4.

There is no mechanical motion until the end of the time delay, and thus nothing has to be retrieved in case voltage returns before the breaker is tripped. Since there is no mechanical motion, there is nothing to wear out or stick except where the relay is used, and even there any faulty operation would trip out the breaker, which is preferable to having it left closed by reason of a fault.

The inductor-type time delay is not affected by frequency, and one device is good for a range of 5 to 5,000 cycles without change of coils or resistance. It has no mechanical connection to the tripping mechanism, and so may be mounted in any convenient location, as on a wall or switchboard. The location should be reasonably dry and the temperature ought not exceed 75 deg. F. It may be connected to any type or make of undervoltage-release device which operates by a holding coil, with the possible necessity of changing this coil for one of suitable resistance.

Duncan, Okla., Municipal Light Plant Reports Power Costs

THE DUNCAN, OKLA., municipal light plant in the year ending July 1, 1930, showed a net profit of $22,984.79 after deduction of all operating and fund expenses. The various terms of cost are shown in the tabulation.

	Total	Per Kw.-Hr.
Power Plant		
Salaries and labor	$9,323.60	.00387c.
Maintenance of power plant equipment	2,684.44	.00111c.
Fuel and lubricating oil	9,328.46	.00388c.
Insurance	575.00	.000239c.
Water, for cooling, 2,281,500 gals	798.52	.000332c.
Miscellaneous expense	894.44	.000372c.
Total maintenance and operation	$23,604.46	.009803c.
Distribution System		
Maintenance of lines and equipment	$1,560.70	.000694c.
Salaries and labor	4,069.20	.00169c.
Total maintenance and operation	$5,629.90	.00234c.
General and Office Expense		
City clerk's dept. one-third total expense	$2,284.00	.00095c.
Mayor and comr's dept. one-third total	1,960.00	.00081c.
Office rent	400.00	.000166c.
Total general expense	$4,644.00	.00193c.
Capital Expense		
Annual maturity of interest, 6 per cent	$18,207.30	.00757c.
Sinking fund, 5 per cent	15,172.75	.00631c.
Total capital expense	$33,380.05	.01388c.
Total expense	67,258.41	.02701c.
Total gross revenue	$90,243.20	
Less expense	67,258.41	
Total net profit	$22,984.79	

✦

THEY ARE BUILDING dams from the top down in New Hampshire. The occasion for this is the approval Public Service Company of New Hampshire recently received for the raising of the dam at its Ayers Island hydro-electric generating station near Bristol, New Hampshire. In raising the dam, the cement core wall for the southeast abutment is being built by pouring the top sections of concrete first, then excavating beneath them, and adding successive sections of concrete. In other words, the abutment is being built from the top down towards the foundation.

Ice-Trouble Remedies in Hydro-Electric Plants

How to keep sluice gates, flashboards, rack bars, headgates, penstocks, surge tanks and waterwheels in operating condition in cold climates. The use of steam, hot water and electric heating, compressed air, and electric lights are included in the suggested methods

By C. R. REID
Assistant General Superintendent
Shawinigan Water & Power Company
Shawinigan Falls, Quebec

IN THE operation of hydraulic power plants where the climate is cold, ice formations may damage the plant or temporarily interfere with operation, unless proper precautions are taken. Sluice gates set in dams are usually of steel, made up of a skin plate supported by a number of horizontal girders which transmit the load to the points of support at the sides of the gate, Fig. 1. The gate is supported against the piers either by sliding surfaces or, more commonly, by rollers. These rollers may either be fixed to the gate or mounted in a separate roller train, as in the Stoney type. Such construction allows freezing temperatures to strike through the gate, and form ice all the way down its upstream face. This ice is thick at the top, where it joins the surface ice, and comparatively thin in the slightly warmer water near the bottom. When a gate is being raised in the spring the process is sometimes accelerated as a result of the ice wedge being drawn under the gate. To guard against accidents of this sort it is advisable to raise the gate while the ice is still strong, so as to get it well up before the ice gives away. Frequently, after a gate is pulled clear, the ice will hold for some time before letting the water through, Fig. 2.

Water leaking through the seals at the sides of a gate is frozen in the roller trains and to the lower side of the gate. A little ice will prevent the correct operation of a roller train. A fixed roller type is probably less subject to interference from a moderate amount of ice.

To keep the face of the gate free from ice it is desirable to inclose it on the back by wooden sheathing, Fig. 5, or by light steel plates with heat-insulating material on the inner surface. The steel plates are less likely to be pulled off by ice that forms on the back of the gate. In addition, heat must be supplied on the inside of the inclosed gate. Electric heaters are often the most convenient. A continuous power input of 60 watts per square foot of skin surface is sufficient to keep a gate

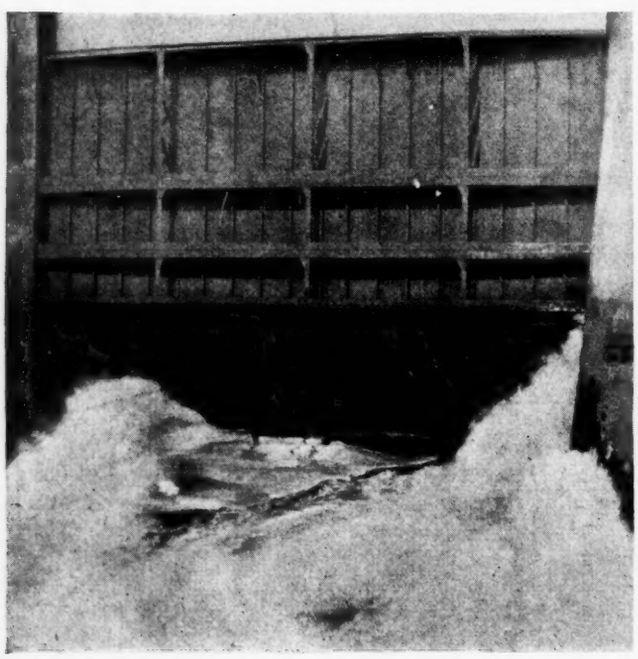


Fig. 1—Sluice gate partly raised and the ice holding the water

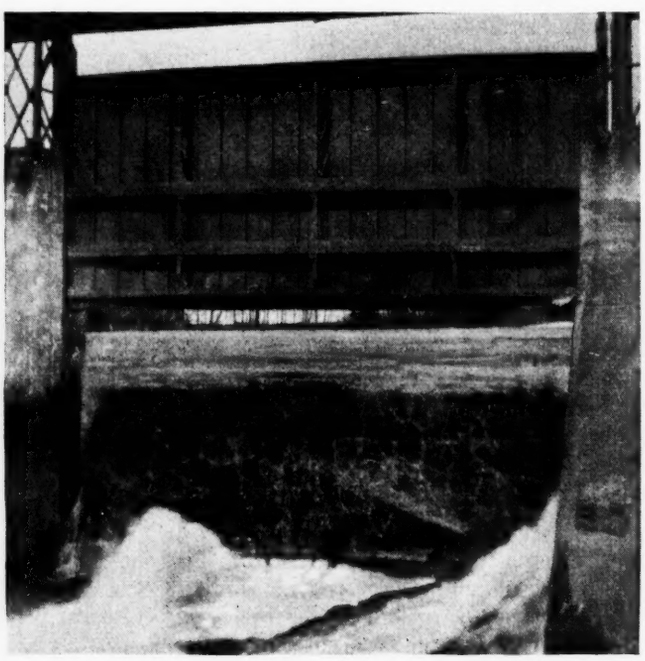


Fig. 2—Sluice gate raised and the ice still holding the water

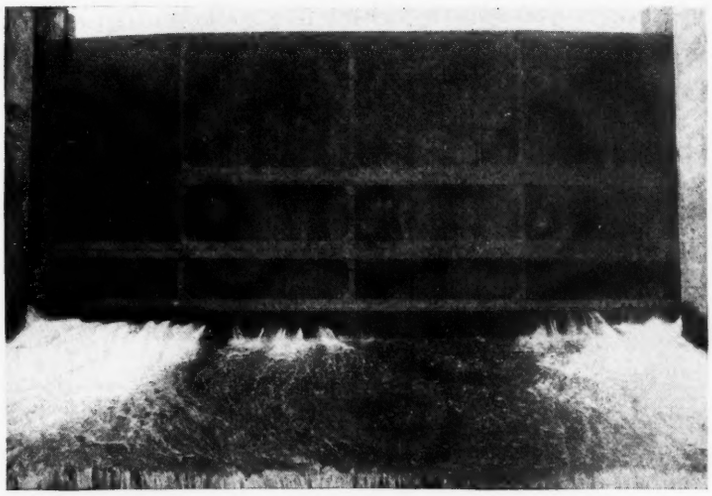


Fig. 4—Back of unin-closed steel sluice gate

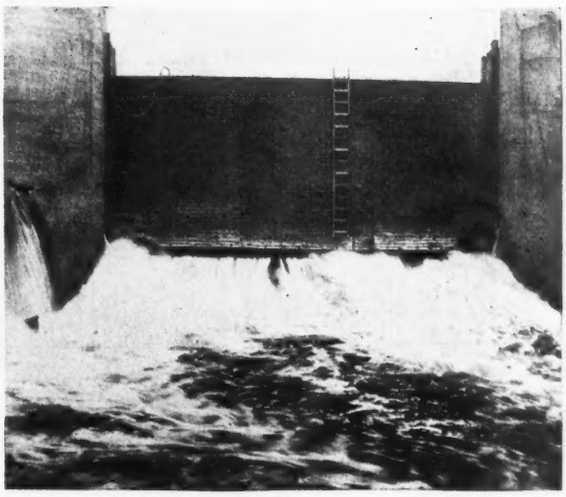


Fig. 5—Back of sluice gate in-closed with wooden sheathing

free under most severe climatic conditions. In this connection it should be pointed out that the upstream face of the gate should be free from projections so as to obtain clearance with a minimum water gap. The electric heaters should be arranged to give a suitable distribution of heat, having in mind that the greatest tendency to freeze is at the surface of the water; also that warm air rises, and water warmed slightly above the freezing point descends. Sometimes electric fans are installed to get proper heat distribution. In addition to the face of the gate, these heaters will also supply heat to the seals at the sides and bottom of the gate, and to the gate side of the roller trains.

To keep roller trains free from ice, it is customary to install a heater, in a suitable compartment, such as in an embedded pipe, adjacent to the roller train on the side opposite the headgate. These heaters should be of 4 or 5 kw. capacity each. A design in which the roller trains are housed in as completely as possible is advisable, not only to keep out trash and prevent displacement of the roller train, but also to prevent excessive heat loss.

Where steam is available it may be used for thawing sluice gates. At one power plant two 20x40-ft. gates are kept free by the application of steam once a day. The steam required amounts to 110,000 lb. per month for the two gates. At this plant a gate was also kept clear of ice on the front by means of compressed air. A compressor driven by a $1\frac{1}{4}$-hp. motor was installed on the dam adjacent to the gate and an air hose connection was made with a horizontal perforated pipe attached to the face of the gate 12 ft. below the surface. With such an arrangement it is necessary to use steam or other form of heat to thaw the roller trains and gate sill. It is probable that compressed air would be more successful in deep than in shallow forebays, as the water brought up from a greater depth by the lifting action of the air would be at a higher temperature.

Flashboards are usually of light construction and not well adapted to stand stresses set up by a heavy sheet of ice. If ice is allowed to freeze fast to flashboards, the rise and fall of the pond level will distort the structure. There is a tendency for broken ice to jam at the point of fracture near the flashboards and to force them back. If the pond level is kept constant, there should be no resulting damage. Where it is not possible or desirable to hold the pond level constant, it is necessary to prevent ice's freezing to the flashboards. This can be done with compressed air as in the case of the sluice gate previously mentioned, or a trench can be opened by hand and covered with boards. Sufficient heat can be applied inside this covering to keep the trench from freezing over. Electric lights are sometimes used for this purpose. Light is supposed to have some beneficial effect in preventing freezing. It is doubtful, however, if anything but the radiated heat is of value.

When open water at freezing temperature is in contact with air at a temperature below freezing, frazil or needle ice is apt to be formed. Anything agitating the water's surface, such as high wind or a rough stream bed, favors frazil-ice formation. These filaments of ice adhere to the rack bars and quickly collect in sufficient quantity to shut off the water flow. It is necessary either to raise the racks or to heat them sufficiently to prevent the adhesion of frazil ice. A very slight temperature increase is sufficient. Rack heating is being done

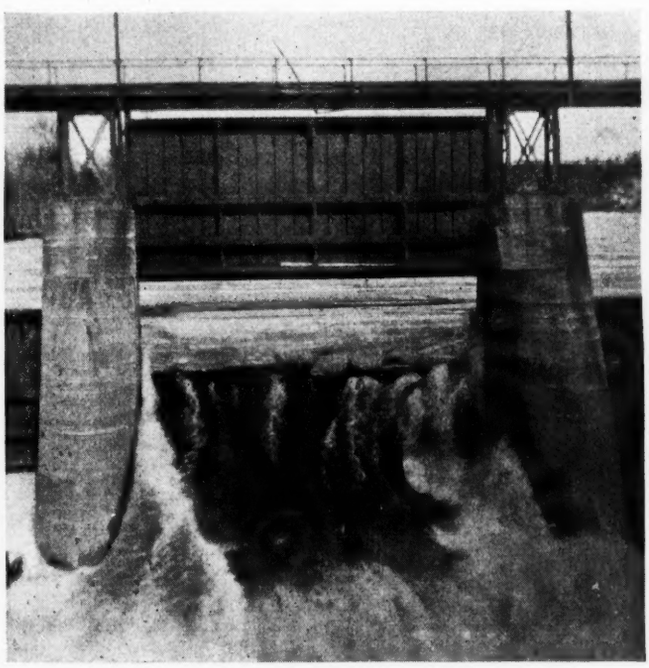


Fig. 3—Same as Fig. 2, after the ice failed and released the water

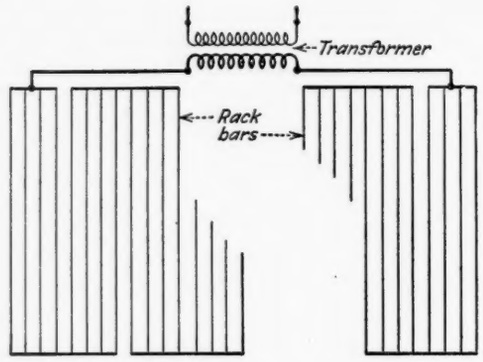


Fig. 6—Diagram of rack bars connected parallel series for heating electrically

successfully by electrical means. Rack bars are insulated by hardwood strips and connected together in a suitable series-parallel arrangement, as in Fig. 6. Wood insulation has been found to be quite satisfactory for potentials up to 220 volts, there having been no failures at one plant after several years' operation. In this installation there is a leakage current of approximately 1 per cent. An empirical formula based on operating experience for the amount of power required for rack heating is:

$$Kw = C\,\frac{Q}{S}$$

in which Q is the quantity of water passing through the racks in cubic feet per second, S is the spacing in inches between rack bars, and C is a constant that varies between 0.4 and 0.7, depending upon the severity of ice conditions and the degree of protection desired.

Headgates, being fairly well protected from freezing on the back, are not so subject to frost action as sluice gates. When covered by a heated gate house they may not require any local heating. However, if frost can strike through from the outside, ice may form in the gate slots, or may freeze up the vents behind the gates. Warm air blown down on the surface of the water, radiant electric heaters with reflectors to throw the heat where desired, and immersion electric heaters are all being used successfully to keep headgates in operating condition in cold weather.

Steel penstocks may be operated under severe climatic conditions without a protective covering if certain precautions are taken. A coating of ice forms in cold weather on the inside of the penstock to a depth depending on the temperature and the velocity of the water. When the turbine is shut down for any length of time, the headgate should be closed, and the penstock drained to prevent its freezing solidly. During a thaw the ice coating is apt to loosen and come down into the turbine, shutting off the flow of water and reducing the power output of the unit. Usually after a few hours' operation the ice clears out and the unit gradually picks up full load. It is inadvisable to unwater a penstock at such a time, as the ice might come down the empty penstock with great velocity and endanger any workmen in the wheel casing or damage the turbine itself.

Surge tanks are particularly subject to freezing, by reason of static condition of the water and the necessity of having vents communicating with outdoors. Ice on the outside walls does no harm so long as it does not loosen. However, a coating of ice over the surface of the water tends to prevent proper functioning of the surge tank. Floating ice is a menace to the steel braces or structures inside the tank, as the ice is thrown violently during a surge. Surge tanks should be well lagged to keep out frost. In some cases electric heaters are installed between the lagging and the steel tank. One concrete differential surge tank, without lagging, 40 ft. in diameter and 80 ft. high, is heated by three electrodes suspended from the roof and connected to a 3-phase, 15,000-volt circuit. An input of 100 kw. is sufficient to keep the surface of the water clear of ice.

In some locations trouble is experienced from ice adhering to the guide vanes and the operating mechanism of the turbines, and sometimes to the runners as well. Trouble of this sort appears to occur most frequently in locations where the water is drawn from near the surface and reaches the turbine through a short penstock or passageway. It is most apt to occur when conditions are right for the formation of frazil ice. In one plant this trouble is combatted by shutting down a unit at intervals, unwatering the wheel case, and turning in steam for a short time. In this plant experiments are

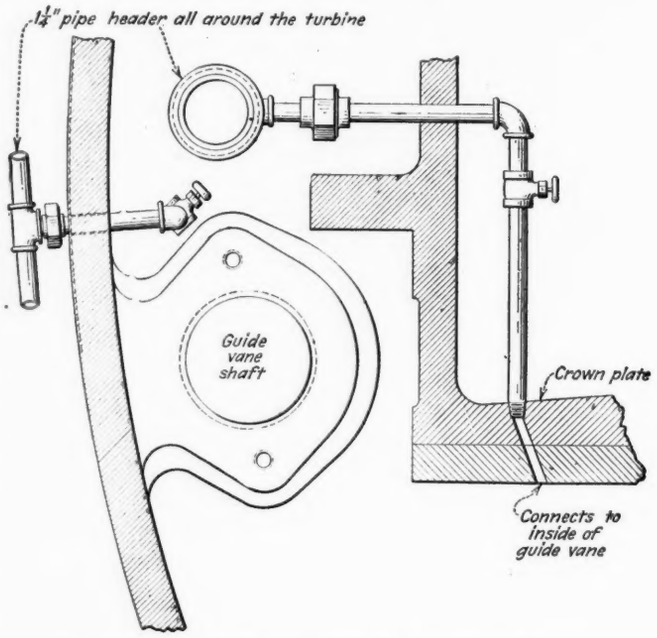


Fig. 7—Piping arrangement for heating guide vanes with hot water

being carried on by applying to the turbine parts windings in which alternating current is used to produce eddy currents to supply the heating necessary to keep the unit free from ice.

In one plant holes were drilled through the turbine casing opposite each guide vane to connect with the cored opening in the guide vane, Fig. 7. Warm water was discharged into these openings and into the space between the head cover and the crown of the runner. The principal benefit derived from this arrangement is that the guide vanes are prevented from sticking. If cored openings or drilled holes were provided through the crown of the runner and into the interior of the runner buckets to a certain depth, it is believed that this method would permit continuous operation under all conditions.

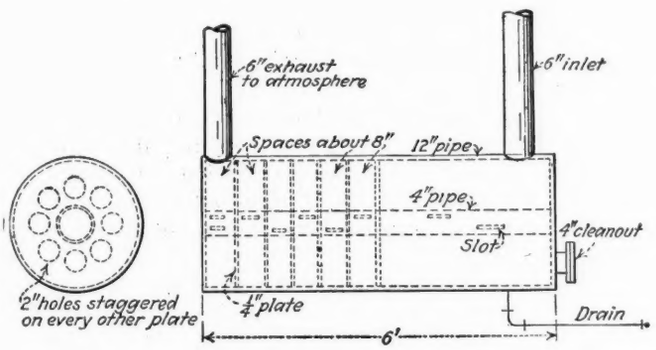
In conclusion, it may be said that ice troubles can largely be prevented by a careful design of the hydraulic plant. However, cases may arise where it is more economical to cure the trouble by the application of local heating rather than attempting to avoid it by designing a more expensive structure.

. . . RIGHT OUT OF THE PLANT . . .

Muffler for Gas-Engine-Driven Air Compressor

IN THE installation of a gas-engine-driven air compressor inside the city limits, noise of the mufflers was a point to be considered before a permit was granted. The vertical type of muffler generally used was considered too noisy. To relieve the noise so far as possible, one was made as follows:

A piece of 12-in. pipe 6 ft. long was used as a shell or chamber. At each end, on the circumference, a piece of 6-in. pipe was welded, one for intake and one for outlet. Up the center of the shell a 4-in. pipe had six



Muffler for gas-engine exhaust made from standard pipe with the aid of a torch

¼-in. plates welded on to it at intervals of 8 in. Four 2-in. holes were drilled in each plate and the plates were staggered on the pipe so that the holes were at 90 deg. to each other. Slots the width of the torch were then cut in the pipe, one in each space between the plates, as shown in the sketch.

The whole assembly was then tacked to an end plate and welded to the shell. At the other end a closing plate was welded in. On the intake side of the shell and at the bottom a 4-in. clean-out flange was welded into a short nipple. A 1-in. drain was led from the bottom into a near-by sump. With this connected up and buried just below the surface, there was practically no noise when the engine was running under full load.

Long Beach, Calif. M. C. COCKSHOTT.

What Recirculation Accomplishes

IN THE July 22 number, under the heading "What Recirculation Accomplishes," J. D. Yoder offered some comments on a previous article in which I had pointed out the benefits of recirculation. This is Mr. Yoder's second published article on this subject (the previous reference being in *Power*, Sept. 17, 1929), and in both instances he has apparently overlooked factors of essential value.

He begins by misinterpreting the purpose of the article, in which only incidental reference was made to possible saving to be effected, and he goes on to explain that recirculation of a portion of the boiler water reduces the amount of steam that could be bled for feed water heating, thus leading to undesirable losses in the heat balance.

He selects a condition where bled steam is used only for heating the feed water, but under such circumstances the make-up will as a rule be relatively small, and water treatment a minor problem. Apparently also his figures are based on a condition in which steam is bled at atmospheric pressure only. Under such a condition it is advisable, when applying recirculation, to add a second heating stage, in which the recirculated water would be cooled to a temperature of about 222 deg. F., compared with the temperature of 212 deg., for the water leaving the treatment system.

Assuming these latter figures, and supplementing his incomplete comparison of this particular feature, with special reference to the effect on the heat balance, the following figures are arrived at, based on 100,000 lb. per hour:

	With Recirculation, Lb. per Hr.	Without Recirculation, Lb. per Hr.
Amount withdrawn from boilers	11,000	5,270
Amount of water flashed at atmospheric pressure from 222 deg.	114	54

Consequently, when using recirculation under the assumed conditions, the amount of exhaust or bled steam that would be used for heating the feed water is reduced by 60 lb. per 100,000 lb. of steam generated, instead of a reduction of 1,214 lb. as figured by Mr. Yoder.

It seems fair to point out that he does not carry to a conclusion an attempted evaluation—this apparently being his principal, in my opinion, but unsound criticism of the previous article.

In estimating the cost of recirculation on the assumed basis, he figures in terms of the kilowatt-hours that might be produced by the same amount of steam at high pressure. This reasoning does not seem logical, since we then find that the loss is much higher than the cost of the heat. Even if all the heat of evaporation of the flashed steam ($1{,}214 \times 970 = 1{,}180{,}000$ B.t.u.) should be lost, this amount of heat would not normally be evaluated at 50c. A commonly accepted average figure for value of heat is 25c. per 1,000,000 B.t.u.

However, as previously shown, the actual difference

is only 60 lb. of steam at atmospheric pressure, and instead of figuring how much energy could be produced when operating at 250 lb. initial, and atmospheric back pressure, it seems more logical, when using the demand for energy as a basis of calculation, to figure as follows:

Recirculation reduces the amount of bled steam by 60 lb. per 100,000, corresponding to 2.5 kw. This amount of energy has to be generated by condensing operation, calling for perhaps 37 lb. of steam per 100,000 lb.. The loss caused by recirculation may be considered equal to the heat of evaporation of 37 lb. of steam at 28 in. vacuum, corresponding to $37 \times 1{,}036 = 38{,}200$ B.t.u. for every 100,000 lb. of steam, or, on a basis of 25c. per million B.t.u., equivalent to 1c. instead of 50c. as calculated by Mr. Yoder.

As previously stated, his calculation and my correction have only theoretical value, since in cases where the large percentage of make-up justifies a hot-process treatment system—such as central heating plants, gas plants and industrial plants requiring process steam—the production of low-pressure or bled steam is the object of the installation, and replacement by recirculating water, for the purpose of heating the feed water, has no effect on the heat economy of the plant.

Although the greater part of his discussion is devoted to an attempt to show the adverse effect of recirculation on the heat balance, he also cautions against drawing conclusions from the illustration given in the original article. It is stated that if the sulphates as Na_2SO_4 had been less than 53.5 parts per million, it would have been necessary to feed sulphates even when recirculation is applied. This conclusion is not correct, because the amount of sulphates in the boiler water is determined by the blowdown, which is established to maintain the desired conditions. If the sulphates in the water were less, the blowdown would be correspondingly less with recirculation, to maintain the desired sulphate concentration in the boiler. In other words, it is usually the sulphate content of the raw water that determines the amount of blowdown, when recirculation is used, and only in rare cases is it necessary to add sulphates.

On the other hand, without recirculation the amount of blowdown is inflexibly determined by the relation between the excess alkalinity in the treatment tank and the alkalinity which it is necessary or desirable to maintain in the boiler. The conclusion is correct, that without recirculation it is necessary to feed sulphates whenever the sodium sulphate in the raw water supply is less than 75 p.p.m. This is true, not only for the water assumed, but for any water, provided that the excess alkalinity in the treatment tank is 25 p.p.m. and a 3-to-1 ratio is desired.

In discussing this particular point, Mr. Yoder has entirely overlooked the flexibility of the system using recirculation, which gives independent control of the sodium-carbonate concentration and the sodium-sulphate concentration in the boiler, these being the two soluble salts in which the operator is most interested. Without recirculation, such independence of control is quite impossible. This is only one of the really important advantages of recirculation. P. M. CONTANT.

New York City.

[In view of the relatively long period over which this discussion has extended, it is felt that the printing of this rebuttal by the author of the original article should close the matter as far as *Power* is concerned.—EDITOR]

Machine Drawings Sent by Transatlantic Radio

THE ARTICLE by G. C. Derry in the July 8 number, entitled "Machine Drawings Sent by Transatlantic Radio," is interesting, but similar drawings were sent by this method at least a couple of years previously. On Feb. 8, 1928, I received in New York by transatlantic radio from our London office two drawings of a boat lift proposed in connection with the Sierra hydro-electric development near São Paulo, Brazil. These drawings were not specially prepared for radio transmission and, while leglible, some small numbers in circles and cross-hatching were slightly blurred. Nevertheless, the transmission was entirely satisfactory.

From the attention which these photographs apparently attracted in the cable company, I imagine that they were among the first thus transmitted, but have not inquired regarding this. The messages were received through the Marconi Company and the Radio Corporation. A. W. K. BILLINGS, *Vice-President,*
Brazilian Traction, Light & Power Co., Ltd.
São Paulo, Brazil.

Wreck of Centrifugal Pump Caused by Faulty Installation

ON A power project in California, some years ago, I witnessed an accident to a centrifugal pump that was brought about by faulty installation. A two-stage motor-driven unit was used to pump water up an 800-ft., 23-deg. incline. The unit was installed without a check valve on the discharge at the pump.

Operation was satisfactory (apparently) so long as two men who were accustomed to the handling of the equipment were on the job. One man would partly close a valve which was in the discharge about 75 ft. up the incline from the pump, while the other would shut off the power to the motor. Then the man at the valve would close it as quickly as possible after the power had been shut off.

One day the unexpected happened. The two men quit their jobs at noon. The shift boss, who had all the best of intentions, could not understand why one man could not handle the pump job. Certainly he didn't take into consideration the nature of the job in this case. At any rate he sent a man down to the pump house who had never handled a centrifugal, or any other kind of a pump.

When the sump was pumped almost dry one of the workmen came up to the pump house and informed the new pump man to that effect. The latter immediately placed the compensator lever in the off position, ignorant entirely of what consequences would follow. The pump casing burst like a charge of t.n.t.

Without a duplicate pump or repair parts on hand, they were compelled to assemble the broken pieces and resort to numerous kinds of clamps and other ways of putting the casing together, which required most of 30 hr. before the pump was again placed in operation. The sump was flooded and three days elapsed before normal conditions were resumed. Later a check valve was installed on the pump discharge.

Butte, Mont. RALPH E. MACKAY.

Environment Influences Plant Operator

IN SOME respects the operating man in a power plant, particularly if it is a small plant, occupies a unique place in the working world. His job is more or less aloof. If it is a one-man plant he spends his working hours in meditation. Day after day he follows the same routine. His mind running along in the same humdrum channel, his outlook is likely to become warped and narrow. What he needs is a thorough awakening. Often a man's light shines under a bushel when only the stimulus of ambition is needed to make it shine in the open, where it will do him and the world some good.

Consider the man on the night shift. His work is important but obscure. He may execute some especially skillful stunt, but there are no observers to applaud the excellence of his performance. Perhaps he broods over the fact and persuades himself that others are getting credit for his fine deeds. Thus he is likely to fall into a resentful state of mind, finally concluding that he is giving value for his wages merely by putting in the night hours on the job and that keeping the plant tuned up is no proper function of his.

Not always is it the engineer in a subordinate station, or those who run the small power plants, whose fires of ambition need stirring up. A bogging down of the personal-efficiency factor is frequently observed even in the make-up of the man who draws high pay for supervising big operations. Not always do we find the high-salaried man's plant in good order. Sometimes an alert stranger dropping in casually may point to disorders that are getting by unnoticed.

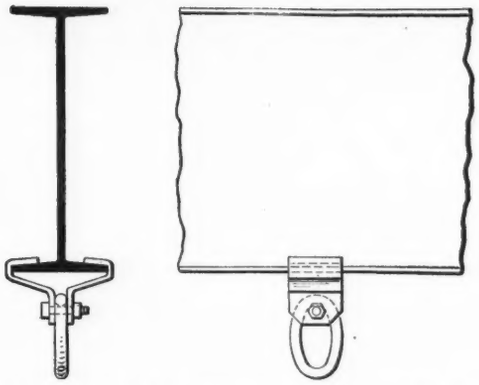
A case in point was that of a large industrial establishment covering several acres of ground. In the boiler house was a long row of water-tube boilers, the furnaces of which were connected to a well-designed masonry stack by an underground breeching. Things ran well until one day the boss fireman reported that something was wrong with the draft. They were having great difficulty in getting the fires to burn properly. For nearly two weeks the chief spent worried hours in puttering around the boiler settings, readjusting the baffles and searching for air leaks. Finally, an engineer paying a visit to the plant suggested that he take a look into the underground breeching. It was half full of water.

St. Louis, Mo. A. J. DIXON.

Convenient Means for Anchoring Chain Hoist to I-Beam

ON PAGE 184 of the July 29 number W. S. Whiting, Jr., describes a "convenient expedient," the use of two links of an industrial conveyor chain for attaching a chain hoist to an I-beam.

Having had many years' experience in handling heavy machinery, I am somewhat surprised that anyone would recommend the use of so flimsy a device. Conveyor chain links are made of malleable iron, rectangular in form, the weakest kind of a link when used for the purpose mentioned. The use of two links as illustrated places the load on the hook in two places, a considerable distance from the center, which in the case of a heavy load would tend to straighten it out.



Safe method of attaching chain hoist to an I-beam

It seems to me that if the load was swung at right angles to the beam one of the links would shift to the middle of the hook, causing it to unhook and let the load fall. I do not consider the use of conveyor links at all safe for this work.

In the accompanying sketch is shown a pair of clamps which we are using for this purpose. They are made in different sizes of mild-steel flat bar stock $\frac{3}{8}$x2 in. to $\frac{3}{4}$x4 in. The latter is safe for a load of six tons.

Mechanicville, N. Y. GEORGE W. CLARKE.

Eighty-Three-Year-Old Engine Still Running

IN STRIKING CONTRAST to the wonderful steam-power and motor-driven machinery in modern manufacturing plants is the old beam engine which has been in continuous service almost night and day for the past 83 years at the plant of Wetherill & Brother, white lead works, 126 South St., Philadelphia. So far as can be ascertained, it is the oldest engine in actual operation in this city. The engine was built in 1847 by J. T. Sutton & Company.

This engine is of the single-cylinder slide-valve type and was originally constructed to develop 40 hp., but is now probably developing 140 hp. or more when running on 100 lb. steam pressure. The beam is carried by a central column 14 ft. high which formerly served as an open feed-water heater, the exhaust steam being led from the cylinder through the engine frame to the column and the feed-water flowing by gravity to the plunger pump worked from the beam. About 22 years ago, however, the use of this heater was discontinued.

The flywheel is about 14 ft. in diameter, and the connecting rod is attached to the center crank by a drag pin. In addition to the machinery driven from the main shaft, a vertical rod extending upward from the beam operates twelve plunger pumps through a system of bell cranks.

It would be interesting to learn whether there is in the United States an engine regularly at work older than this veteran in the Wetherill white lead factory.

Philadelphia, Pa. A. C. HORN.

[Pictures and a description of this old engine were published in *Power* on page 771 of the Nov. 21, 1911, issue. It is interesting to know that it is still in operation.—EDITOR]

From Among Readers' Problems

Conducted by

L. H. MORRISON

HEAT TRANSFER IN A CLOSED HEATER—*We wish to install a closed heater to handle 100,000 lb. of exhaust steam per hour. What should be the square footage of surface?* D.W.

The coefficient of heat transfer varies with the velocity of the water, being 400 B.t.u. per hour per degree of temperature difference with a velocity of 1 ft. per second, 800 B.t.u. when the water velocity is 4 ft. and 1,000 when the velocity is 7 ft. per second.

On the basis of 4 ft. per second, and assuming 970 B.t.u. to be removed per pound of steam, and a mean temperature difference between the steam and the water of 100 deg., the surface should be

$$\frac{970 \times 100{,}000}{100 \times 800} = 1{,}225 \text{ sq.ft.}$$

You should take up the matter with a heater manufacturer, who can give you actual values of heating surface.

TRISODIUM PHOSPHATE IN DRINKING WATER — *Can I use trisodium phosphate in boilers where steam is condensed and condensate is used for drinking water and making ice?* G.S.

The phosphate would give the water a disagreeable taste, and while not poisonous, might have the same effect on a person as gypsum water.

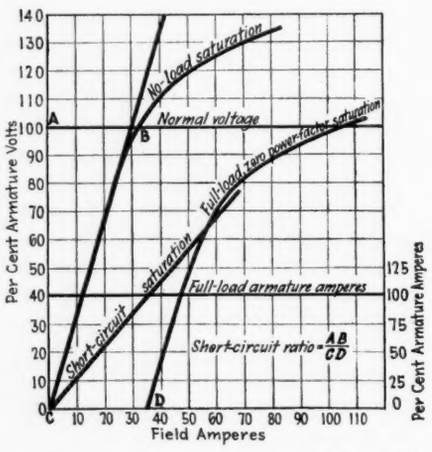
SHORT-CIRCUIT RATIO—*How is the short-circuit ratio of an alternating-current generator determined and how does this influence the machine's characteristics?* M.W.

The short-circuit ratio of a synchronous machine is defined as the ratio of the field ampere-turns required to produce rated voltage at no load and at rated frequency to the field ampere-turns required to produce rated armature current at sustained short circuit. In the figure it is the field ampere-turns, represented by *AB*, divided by the field ampere-turns corresponding to *CD*. In other words, short-circuit ratio is an expression of the relative strength of the armature and field of a machine. A machine with a high short-circuit ratio is one that has a strong field with respect to the armature, and therefore has good inherent voltage regulation and stability because the demagnetizing action of the armature has relatively less effect in reducing the main flux and hence the induced voltage.

Before the development of the voltage regulator, short-circuit ratio was one of the most important considerations in generator design. Values as high as 4 and 5 were quite common and were necessary to prevent large changes in voltage with changes in load.

The voltage regulator has now been developed to a point where the generator field excitation can be changed at a sufficiently rapid rate to prevent any appreciable fluctuation in voltage with changes in load. Consequently, short-circuit ratio has become relatively unimportant from the standpoint of voltage regulation, and values from 0.7 to unity are now considered normal.

In recent years there has been considerable discussion of short-circuit ratio along with other factors that affect



Saturation curves of synchronous machines

stability as applied to heavily loaded, long transmission systems. This refers particularly to the amount of load that can be carried before the system approaches the point of pull-out and hence becomes unstable. Rapid strides have recently been made in the application of high-speed excitation which minimize the importance of high short-circuit ratio in this field also. The term high-speed excitation refers to the rate at which the exciter voltage can be built up and applied to the main generator field. This rapid increase in field excitation increases the synchronizing power of the machines on the system and thus the amount of load that can be transmitted before pull-out occurs. Greater stability can usually be obtained by the application of high-speed excitation than by the use of reasonably high short-circuit ratio machines.

QUARTER-TURN BELT DRIVE FOR PUMP—*We are driving a vertical deepwell turbine pump with a 40-hp., 440-volt alternating current induction motor connected to the pump by a crossed belt. The speed of the pump is 1,750 r.p.m., and it is fitted with a 12-in.-diameter pulley. The motor speed is 1,200 r.p.m. and has a 17.5-in.-diameter pulley.*

Will you please advise the size of belt necessary, the distance from center of the pump to center of motor, the height of the center line of the motor above the center line through the pump pulley at right angles to the shaft and also just how to proceed to properly align pump and motor.

We have had considerable trouble with the belt breaking and tearing through the center, which has resulted in considerable belt expense. M.A.J.

At 1,750 r.p.m. and with a 12-in. pump pulley, the belt speed is 3.1416 × 1 × 1,750 = 5,498 ft. per minute. This is entirely too high a speed and it should be lowered by reducing the size of both pump and motor pulleys. The high belt speed is probably responsible for the trouble experienced.

It would be better to reduce the motor to 14 in. and make the pump pulley 10 in., which will give a belt speed of 4,398 ft. per minute, and with the probable slip still permit the pump to run at 1,750 r.p.m.

If a double leather belt is to be used, a width of 8 in. will give an ample margin of over-capacity. The pulley centers should be at least 12 ft. apart. In arranging the quarter turn, a plane passed through the center of the driven pulley face should be tangent to the leaving side of the motor pulley face, and the plane through the center of the motor pulley face should be tangent to the leaving side of the pump pulley. If it is found that the weight of the belt causes it to run off the motor pulley, the latter should be lowered slightly.

RATIO OF FURNACE VOLUME TO BOILER RATING—*What is the average ratio of furnace volume to the boiler rating in case of pulverized coal?* L.A.C.

The ratio of furnace volume, in cubic feet, to boiler heating surface, in square feet, varies from 0.11 to 0.18, depending upon the over-rating the boiler is to cover.

PREVIOUS QUESTION

Discussed by Readers

THE QUESTION

CERTAIN brass parts about our water system become spongy. An architect has recommended that in our new plant brass pipe be used in our water system. Is this advisable along the sea coast?

C.M.

IT IS KNOWN that when two unlike metals are submerged in a salty or acid solution and in contact with each other a small electric current is set up, and at the same time one of the metals is dissolved into the solution. The amount of current produced, and, likewise, the amount of decomposition of the metal, varies greatly for different metals.

Brass, being composed of two metals, zinc and copper, is subject to this electrolytic action in two ways: First, by the local action between the small particles of zinc and copper which appear on the surface of the brass, and, second, in a much larger proportion by the action set up between the brass and any other metal with which it may be in contact when in a salt or acid solution. In the latter case, the ground may serve as a metal and a strong electrolytic action may be set up between the brass and the earth.

Consequently, brass pipe used with salt water is always subject to the effects of electrolysis and in time becomes eaten away and spongy. Electrolysis keeps the pores of the brass open, liberates hydrogen and oxygen and permits the chloride salts of zinc and copper to be formed. Most of these salts are poisonous, and special precaution is necessary when opening a system that has been unused for a long time. The water should be allowed to flow freely for considerable time before using for drinking purposes.

Unfortunately, chloride solutions attack most metals, nickel being one of the rare exceptions. Wrought iron, cast iron, steel, copper and lead are all subject to its attack, and decompose more readily than does brass under similar conditions. Consequently, brass pipe has been and is being used wherever salt water is present in the system. While not free from the attack of electrolysis, it withstands it better than the other metals. Nickel pipe is used to some extent, but is almost prohibitive on account of cost.

My suggestion would be to use the brass pipe and combat the electrolytic action by employing an electrical anti-corrosion device or system, several of which are known and work fairly satisfactorily.

STANTON D. BARCLAY.
Brooklyn, N. Y.

THE QUESTION does not state the composition which was advised. Brass is usually composed of zinc and copper, the percentage of zinc varying from 5 to 40 and of copper from 95 to 60. The information as given would imply that a brass of high percentage zinc was used and became spongy from dezincification, a condition where the zinc is attacked by either mineral or gaseous constituents of the water.

As the location of the plant is near the sea coast, the dezincification may be due to oxygen or carbon dioxide in the water and also to the presence of magnesium chloride. This latter constituent is often found in water supplies near the coast, and under favorable temperature conditions it is decomposed to hydrochloric acid and magnesium hydrate. Although the content of acid would be very small, the action, in time, would be sufficient to attack the zinc and produce a spongy or porous condition of the brass pipe. This same spongy condition is also experienced in water systems because of the dissolved gas in the water when no mineral constituent is present to be decomposed.

The pipe most suitable for a hot-water system is copper and the next most suitable is red brass having a high percentage of copper and a low percentage of zinc. If either copper or red brass pipe is too expensive, and iron or steel should be considered, a deaërating heater should be installed with the iron or steel pipe. There are several types of deaërating heaters for hot-water systems that remove oxygen or carbon dioxide and still maintain the water temperature at the desired degree.

Silicate of soda is also used as a protection against corrosion in ferrous pipe, but the objections to silicate are that it is not effective beyond 200 ft. from the point of application, and thus several points of introduction are necessary.

D. C. CARMICHAEL.
Wilmington, Del.

A Question for Our Readers

WHAT effect on the plates, tubes and other metal parts does changing a boiler from a high-pressure to a low-pressure installation have? My experience is that where this is done the plates and tubes pit and corrode, and it is my belief that at the lower pressure the temperature of the water is just about right for active corrosion and pitting. J.C.

Suitable answers from readers will be paid for and published in the Dec. 16 number.

DEZINCIFICATION of the brass is the cause of the trouble. In other words, the brass, a mechanical mixture, is being attacked either by small electrolytic currents or by some corrosive action of the water which removes the zinc and leaves the metal spongy and porous.

If brass pipe is installed in the new system, four remedies are available to protect the system from similar damage. The first consists of installing at different points in the line cast-iron spool pieces. The distance between spool pieces is generally about 20 ft. The spool piece is simply a cast-iron flanged or screwed fitting from 6 to 12 in. in length and of the same inside diameter as the pipe and sufficiently heavy to withstand the water pressure in the line. Experience will dictate the frequency of inspection necessary.

A second method of protecting the whole system consists of installing zinc boxes in the line at about 50-ft. intervals. The zincs must be inspected and renewed as found necessary. If the corrosive action is confined to one area, as in the case of a condenser on the cooling-water side, protection can be obtained by installing zinc plates in the condenser water-boxes. The plates should be about $\frac{5}{8}$ in. thick and should be mounted on long studs so that they will be near the area to be protected and also in the water stream, which will keep the plates free of deposit and thereby continuously active. The zincs must make metallic contact with the rest of the system, which, in turn, must be grounded. The condensers of all naval ships are protected in this manner.

The piping to and from the condensers, however, is of copper, tinned on the inside. Tinning also may be used to protect brass piping. There are also many paint compounds on the market which will protect metal surfaces from corrosion. In selecting the brass pipe to be used, the 80 copper-20 tin or the 85 copper-15 tin composition, should give the best results.

San Pedro, Calif. T. A. SOLBERG.

DISSIMILAR metals in water containers and pipes suffer greatly from electrolysis. Sponginess is caused by the absence of one of the constituents in the original alloy which has been dissolved out. The remaining metal will possibly be found to have the lower electromotive force compared to the pipe. The metals that have been dissolved will have the highest electromotive force.

By all means use brass pipe throughout and brass fittings. Allow no other metal to be installed in the water system and electrolysis will be largely overcome.

St. John, N. B. J. C. NUTTER.

THE ENGINEER'S BO

Coal Processing Chemistry

COAL CARBONISATION. *By R. Wigginton, Lecturer in Fuel Technology, University of Sheffield, England. Published by Charles C. Thomas, Springfield, Ill.; 1930. Cloth, 8½x5½ in.; 287 pages, 47 illustrations. Price, $6.50.*

INTEREST in coal carbonization is of three kinds: First, there is the plant operating force and designing engineers, who wish to know how carbonizing equipment is designed and operated. This might be called the mechanical engineering interest. Then there is the group which is chiefly interested in carbonization as a heating process and whose interest might be described as of a chemical engineering nature. Finally, there are those whose interest is chiefly concerned with the chemical changes that occur during coal carbonization and the working up of the byproducts and who may be grouped as chemists.

The first and second of these groups already have at their disposal a copious literature, modern enough in character to be really useful. The third group, however, has few useful texts available, at least in the English language. This fact makes Mr. Wigginton's work particularly timely.

After two short chapters, 49 pages all told, devoted to the early history and subsequent development of coal carbonization equipment, there are five lengthy chapters dealing primarily with the chemistry of the operations carried out in the coal-processing industry. The action of heat on coal, coal gas, ammonia and its recovery, coal tar, and the formation and properties of coke are the subjects treated.

The work is not exhaustive, but it is complete enough to promise distinct utility to the chemist who is connected with a carbonization plant or desires to make such connection. Nowhere has the present writer seen the chemical side of the industry treated with as great clarity, within such short compass.

Reviewed by G. L. MONTGOMERY.

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Heat Engines and Muscles

THE THEORY OF HEAT ENGINES, INCLUDING THE ACTION OF MUSCLES. *By J. S. Haldane. Published by Oliver and Boyd, Tweeddale Court, Edinburgh, Scotland; 1930. Cloth, 5¼x8; 118 pages. Price, 6 shillings.*

TILTING against windmills has been largely the pursuit of fictional Don Quixotes, but after a careful examination of this book, the reviewer is inclined to feel that the sport is no longer confined to the novelists, who after all, permitted the world to share in the joke on the addle-pated hero.

The author takes as the motif of his treatise the proposition that Carnot erred badly in his hypothetical reversible cycle. As he points out, various obstacles prevent the Carnot cycle efficiency from being obtained, and he chides the engineer for setting up the cycle as the target at which to aim when assaying a new design. He elaborately points out that heat losses to the cylinder walls, exhaust losses and imperfect combustion in a gas engine will always prevent the actual machine's achieving the efficiency Carnot set down as $\frac{T_1 T_2}{T_1}$. This is most certainly charging windmills at full gallop. So far as the reviewer knows, no modern engine designer ever aspires to a Carnot efficiency, for he is dealing with another cycle entirely—the Otto, the diesel or the dual cycle. Each of these has what might be termed efficiencies of the perfect engine, and upon one of them our designer trains his eyes. He never hopes to reach the goal, for he is hindered by the imperfections of the actual machine, but little by little these blemishes are being removed.

Mr. Haldane is by no means consistent in his deductions. He claims that the cylinder contents in a Carnot engine can never quite attain the temperature of the hot surface, nor the temperature of the cold surface; but, when he turns to the steam engine, he blithely agrees that the boiler temperature and the condenser temperature are reached by the cylinder steam. The engineer will rather insist that the steam temperature is far below the furnace temperature and some degrees above that of the condenser water.

The volume is interesting principally as an exposition of what a biologist thinks of engineering.

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Engineering English

A HANDBOOK OF ENGLISH IN ENGINEERING USAGE. *By A. C. Howell. Published by John Wiley & Sons, 440 Fourth Ave., New York City; 1930. Cloth, 6x9 in.; 308 pages. Price, $2.50.*

THAT ENGINEERS as a class often find it difficult to express their thoughts clearly and concisely, using just the proper words, is generally conceded. To meet this situation, the author, an associate professor of English at the University of North Carolina, has prepared the text in the form of a handy reference and through the generous use of "right" and "wrong" examples is able to impress upon the reader the correct form and word. The chapters on business should prove especially helpful.

Professor Howell is to be congratulated upon the results of his effort.

Simple Electric Tests

ELECTRIC TESTING SIMPLIFIED. *By Harold H. U. Cross. Published by Crosby Lockwood & Son, London, England; 1930. Cloth, 5x7½ in.; 191 pages, 104 illustrations. Price, $1.20.*

MOST EVERYONE comes into contact with problems where a knowledge of simple electric testing would be helpful. It is to supply this information that this book has been written. The simple tests that a mechanic or an electrician might be called upon to perform are included.

The first chapter gives the simple fundamentals of electric circuits and these are followed by instructions on the use of micrometers and wire gages. The construction and use of voltmeters and ammeters are explained. The use of meghom meters have become popular for testing insulation and this subject has been given considerable space. Other subjects included are: power measurements, synchronizing, storage batteries and the care and inspection of meters.

The material in this book is presented in a simple and practical way and will be useful to those wishing to attain a knowledge of the more commonly used electrical tests.

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Science and Life

SCIENCE AND THE SCIENTIFIC MIND. *Twenty-four essays collected by Leo E. Saidla and Warren E. Gibbs. Published by the McGraw-Hill Book Company, 370 Seventh Ave., New York City; 1930, Cloth, 6x8½; 506 pages. Price $3.00.*

THIS COLLECTION of notable essays on the relationship of science and scientific ways of thinking to other aspects of life is obviously a textbook for an undergraduate course in English. "Tonight read Millikan, tomorrow read Tyndall," some potential engineer will be told, "and bring in a comparison of their points of view on Wednesday." Perhaps the pedantic introductions and the first and second appendices can bear up under the vituperation that the book will receive from such readers, but the essays themselves deserve a better fate.

To enjoy the keen intellectual delight that their content can afford, the essays really ought to be discovered accidentally, individually, at intervals six months or more apart. At least they should be read with that enthusiastic concentration that can only come from voluntary perusal.

Those who look to these expressions for some splendid central pillar by which science supports our civilization will

'S BOOKSHELF

look in vain. Here are those who see all true culture as a manifestation of scientific thought, those who see all scientific thought as a manifestation of true culture, and those who see scientific thought and the emotional evaluation of experience as eternally opposed.

Beneath all of these valiant efforts to correlate various fields of human endeavor and various ways of looking at life we do find, however, a basic truth that would have been missed if the essays had not been brought together in a single volume. And that basic truth may well be the essence of the scientific method of thought. It is simply this—that no generalization can be accepted beyond the bounds of experience in which it has been created. Realizing the widely variant types of experience—material, mental, and emotional—that have gone into the minds of the twenty-four individuals whose ideas are here expressed, any agreement of conclusions on the part of the group would necessarily violate this fundamental principle. In other words, they do not agree on the nature of science or scientific thought, yet their very disagreement substantiates this basic truth.

Reviewed by E. SCOTT PATTISON.

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Canada's Fuel Problem

THE FUEL PROBLEM OF CANADA. *By Martin Nordegg. Published by The Macmillan Company of Canada, Ltd., 70 Bond St., Toronto, Ont.; 1930. Price, $1.50.*

FUEL concerns everybody's welfare, comfort, and pocketbook. It is one of the chief essentials of life, and enters into the production of everything. At present, it constitutes a pressing national problem for Canada, which Mr. Nordegg maintains can only be solved by a sane national policy. In this book on the subject he makes suggestions which ought to win the profitable consideration of every citizen. The author stresses the great handicap of distance from the mine to the market, and the resulting competition with foreign supplies, and urges consideration of the fuel problem from a national standpoint.

In Part I, the present state of the fuel problem is presented under such headings as, Fuel, The Government and the Nation; the Coal Fields and Mines; the Marketing of Coal; The Railways and Coal; Industrial and Domestic Markets; Importations of Coal; Exportations of Coal; Labor Conditions; Peat; Petroleum; Natural Gas; and Hydro-Electric Power. In Part II the possible solutions of the fuel problem are discussed as follows: (*a*) Technical: Carbonization of Coal; Gas Plants; Central Heating; Pulverized Coal. (*b*) Organization: Legislation; Dominion Fuel Commission; Amalgamation of Mines; Coal Syndicates.

That the author is willing to back his arguments is evident from the following quotation from the preface: "As this presentation will doubtless result in discussion and polemics, even contradiction, its main purpose will be attained, mainly to stir up a greater interest in the problem; and after weighing the possible animosity, perhaps even attacks which the author will encounter from quarters not able to stand just criticism, he nevertheless has the courage to tell the truth as he finds it."

Diesel Design Data

CALCULATIONS FOR DESIGNING A FOUR-CYCLE DIESEL ENGINE. *By Dr. W. Halder. Published by Richard Carl Schmidt & Company, Lutherstr. 14, Berlin W. 62, Germany; 1930. Cloth, 5x7½ in.; 372 pages, 200 illustrations. Price, 24 RM. (about $6).*

DUE to the limited demand in this country, there is little inducement for an engineer to write and for a publisher to print a book on diesel design. The number of designing engineers in Germany make such a volume feasible, and Dr. Halder is to be congratulated on the completeness of his treatment of the design of a four-stroke-cycle solid-injection diesel engine. Taking a single engine as the basis, he has proceeded to design all the necessary parts, showing the methods of computation. Probably not all designers will agree with his allowable stress values, nor approve of his design details, but basically they are those which have been proved correct by experience.

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Brief Reviews

FORSCHUNGSARBEITEN AUF DEM GEBIETE DES INGENIEURWESENS. Vols. 330 and 334. Published by VDI-Verlag G.m.b.H., Dorotheenstr. 40, Berlin NW 7, Germany. Paper, 31 and 46 pages, respectively, illustrated; price, 5 and 8.5 RM, respectively. —Vol. 330 contains a study by Prof. E. Berl and Dr. F. van Taack giving further data on the research work of the VDI Feed-Water Committee on the subject of corrosion in steam boilers. It concerns the action of lyes and salts on mild steel under high-pressure conditions and the protective action of sodium sulphate against attack by caustic soda and magnesium chloride. Vol. 334 contains a study by Dr. Kurt Neumann on the scavenging and charging process in two-stroke-cycle diesel engines. It also contains a study by Dr. Otto Klüsener on the working process of high-speed two-stroke-cycle carburetter engines. Both volumes are published in German.

GEFÄLLVERMEHRUNG BEI NIEDERDRUCK - WASSERKRAFTTANLAGEN. By Dr. Rudolf Gelbert. Published by Wilhelm Ernest & Sohn, Wilhelmtr. 90, Berlin W 8, Germany. Paper, 22 pages, illustrated; price, 3.6 RM.—A report in German on increasing the head at the Niederdruck hydro-electric power plant.

ICE PROBLEMS IN HYDRO-ELECTRIC PLANTS. AUTOMATIC AND PARTIAL AUTOMATIC HYDRO-ELECTRIC PLANTS. MECHANICAL RELIABILITY OF HYDRO-ELECTRIC UNITS—1928. BIBLIOGRAPHY OF HYDRO-ELECTRIC SUBJECTS AND MANUFACTURERS' STATEMENTS. Publications No. 082, 083, 084 and 086, respectively, of the National Electric Light Association, 420 Lexington Ave., New York City. Paper, 9, 19, 12 and 20 pages, respectively, illustrated; prices, 30c., 50c., 40c. and 60c., respectively, to non-members.—These four publications are reports of the Hydraulic Power Committee of the N.E.L.A. Engineering National Section. The first, No. 082, describes methods used at water-power plants to maintain operation under winter conditions. No. 083 presents the salient features of automatic and semi-automatic hydro stations. No. 084 gives the outage records of 191 units for the year 1928, classified as to type of turbine and cause of outage. No. 086 is the committee's annual bibliography and review of important data on hydro-electric plants published during 1929.

GENERAL RULES AND REGULATIONS PRESCRIBED BY THE BOARD OF SUPERVISING INSPECTORS. Published by the Steamboat Inspection Service of the United States Department of Commerce. Paper, 230 pages.—Contains the latest regulations covering boiler installations in ships on the Great Lakes.

JOURNAL BEARING PRACTICE. By Francis Hodgkinson. Published by the Institution of Mechanical Engineers, Storey's Gate, St. James' Park, London, S.W.1, England. Paper, 52 pages, charts and tables.—Excerpt minutes of meetings of the I.M.E. in London and Manchester on Nov. 15 and 28, 1929, devoted to a consideration of journal bearing practice.

WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

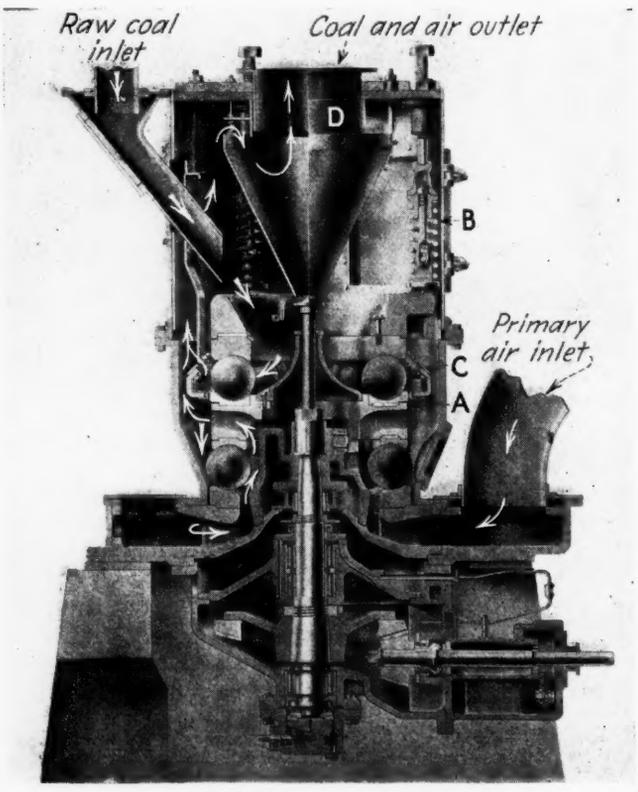
Improved Pulverizer Embodies Many New Features

FOLLOWING a number of successful installations information has become available on the new Type B pulverizer put out by the Fuller Lehigh Company, Fullerton, Pa.

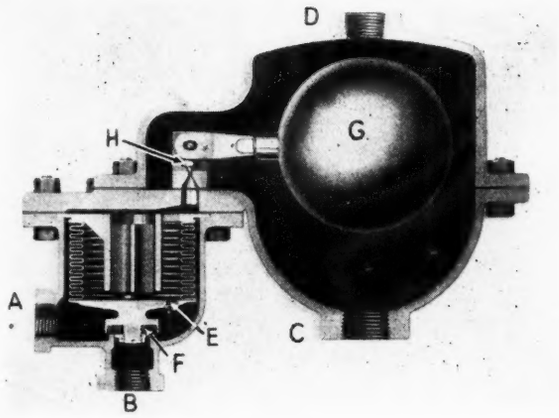
Although embodying the spherical ball and grinding ring principle of pulverizing used in the standard Lehigh mill, Type B has two rows of balls instead of one, and one rotating and two stationary grinding rings. The two rows of balls, one row mounted above the other, are separated and propelled by the rotating ring *A*, which is driven by, and floats on, the main driving shaft in such a manner that no loading is transmitted to the thrust bearing. The pressure between the balls and the rings, which is an important factor in obtaining fineness and capacity, is obtained independently of the mill speed. This pressure is applied and kept uniform by externally controlled steel springs *B* mounted in the top section, as shown.

The main driving shaft runs in two roller bearings and is supported at the lower end by a self-aligning, heavy-duty thrust bearing. Bearings are lubricated by an automatic force-feed oiling system, the pump being mounted inside the housing and driven off the horizontal shaft. The bearings and complete driving gear are effectively protected against dust by an air-pressure (2 to 3 lb.) seal and a throw ring mounted on the shaft above the upper shaft bearing. Any leakage of dust at this point is readily observed upon inspection of the annular space between the air inlet chamber and the bearing housing. The path of the coal and air through the unit is indicated by the heavy and light arrows, respectively. Raw coal crushed to the required size drops from the feeder, through the spout shown, on to the rotating cone inside the upper row of balls, whence it is thrown outward into the path of the balls by centrifugal action. After being ground in the upper row of balls it passes through the annular opening formed by the intermediate grinding rings *A* and the coal basket *C*. Any foreign material, such as tramp iron, pyrites and rock, is discharged by the balls to the coal basket. Upon passing through the opening the coarser particles drop to the lower row of grinding balls for further pulverizing, while the finer particles are entrained by the air stream.

The separating air, admitted to the grinding zone through cored passages in the base of the mill, moves upward inside and through the lower row of balls, then outward through the cored holes in the intermediate grinding ring *A*. These changes in direction of the air stream tend to cause the coarse particles to readily separate from the fine. Separation is further assisted by the adjustable sleeve *D* at the discharge of the mill, which also prevents the coal stream from short circuiting through the classifier. It is pointed out by the manufacturer that the new mill is especially well adapted to the use of preheated air as a separating medium. The absence of lubricated bearings within the pulverizing zone precludes the necessity for limitations on the allowable temperature of incoming air; consequently the temperature of the air can be adapted to suit the surface moisture content of the coal. The unit can be operated either as a pressure or suction mill, as best meets the requirements of the installation. When used as a pressure mill, good distribution of the coal and air to a number of burners is obtained by taking the leads to the burners directly off the top of the mill without the use of an auxiliary distributor. The new unit is available in capacities up to and including 40 tons of coal an hour.



Cross-section of Type B pulverizer



Cut-away view of Webster boiler protector

Device to Protect Heating Boilers Against Low Water

THE DEVICE illustrated, designated Webster boiler protector, has been developed by Warren Webster & Company, Camden, N. J., to protect low-pressure heating boilers against accidental low water level.

The protector is installed with its water line 1 in. above the bottom of the boiler gage glass or approximately 3 in. below the normal boiler water line. It is, therefore, inoperative as long as the boiler water line is maintained in normal position. While the protector will operate as a "feeder," the manufacturer recommends that the normal water level be maintained by manual control.

Referring to the illustration, the pressure of the raw water supply is maintained on connection *A* and in the chamber beyond. A fixed orifice opening at *E* allows the bellows to be normally filled with water at the same pressure. The water valve *F* will be held on its seat by the water pressure. Connection *D* is made to any outlet in top of the boiler not connected to the steam line. Connection *C* is made to the water header or water space at the bottom of the boiler.

When the water level falls below normal the float *G* drops, opening the valve *H*. Then water is discharged through valve *H* in small quantities into the boiler by way of connection *C*. While the discharge rate through valve *H* is small, it is much greater than the rate at which water can flow into the bellows through the orifice at *E*. This causes a definite drop in pressure between the inside and outside of the bellows. This pressure difference compresses the bellows, lifting the valve *F* from its seat, and allows water to flow into the boiler through connection *B*.

As soon as the boiler water level has reached the safety line at which the protector has been placed, the float *G* will rise and close valve *H*. When the pressure on the inside and the outside of the bellows becomes equal valve *F* will seat, shutting off the line to the boiler.

The protector is applicable to practically all sizes of low-pressure heating boilers where the maximum boiler pressure will not exceed 15 lb. The maximum allowable cold water main pressure is 150 pounds.

Three-Position Pilot Switch

TO MAKE POSSIBLE convenient manual starting and stopping of motor-driven pumps, compressors, and similar machines which are controlled by an automatic pilot device such as a float switch, time clock, etc., Cutler-Hammer, Inc., 190 12th St., Milwaukee, Wis., has developed the new three-position pilot switch illustrated.

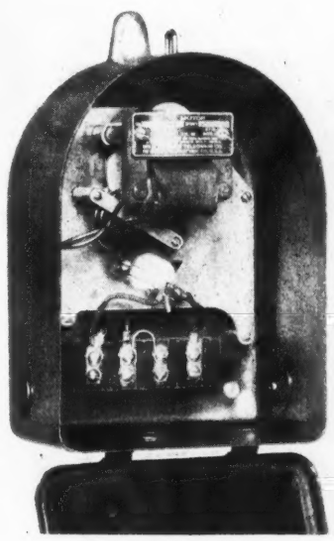
The operating lever can be placed in either the "automatic," "off" or "manual" position. When turned to "automatic," the automatic pilot device is in circuit and normal, automatic operation is obtained. With the lever in the "off" position, the pilot circuit is opened and the motor cannot be started from any other control point. Turning the lever to the "manual" position closes the control circuit directly and the motor will run continuously.

The pilot switch consists of a push button switch inside the case, the two buttons of which are operated by a cam attached to the operating lever. The lever will remain in any one of the three positions.

Switch gives manual control of automatic control circuits

Automatic Time Switches

AN AUTOMATIC TIME switch for closing and opening electric circuits at short predetermined intervals and on a uniform schedule is illustrated. The time cycle, which may be a few minutes or several hours and is repeated continuously, depends upon the gearing used, and is fixed in each case at the factory. In certain forms, however, the relative amount of time "on" during the complete time cycle can be varied by the user.



Time switch with case open

The switches are single-pole, with one-way or two-way contacts, and are rated 5 amp. at 115 volts or $2\frac{1}{2}$ amp. at 230 volts. On circuits of higher ampere rating a magnetic switch can be employed in conjunction with the time switch. The switch is put out by the General Electric Company, Schenectady, N. Y.

NEWS of the FIELD

Spot News

DEDICATION *and formal opening of the Jersey Central Power & Light Company's new high-pressure generating station at South Amboy, N. J., took place on Oct. 31, with Governor Larson of New Jersey closing the switch that placed the plant in service. Using a boiler pressure of 1,400 lb. with an initial installation of 50,000 kw., the new station is designed for an ultimate capacity of 300,000 kilowatts.*

PERMISSION *was granted last week by the War Department to the Milwaukee Electric Railway & Light Company to enlarge and deepen the lower reaches of the Sauk River and the harbor of Port Washington, Wis., at an estimated expenditure of $25,000,000. The contemplated improvements include increased harbor facilities and construction of coal-handling facilities for the company's 320,000-kw. steam-electric generating station now being erected at Port Washington.*

TO MEET UNEMPLOYMENT, *plans for the construction of Hoover Dam have been expedited so that work may be started six months earlier than had been intended, Secretary of the Interior Wilbur reported on Oct. 28 to Secretary of Commerce Lamont, as chairman of the President's advisory committee for employment, made up of cabinet members.*

FORMAL OPENING *at Vacaville, Calif., of the first of more than 100 plants for the service of liquefied natural gas by the Natural Gas Corporation of California to cities and towns on the Pacific Coast took place recently. Marking an epoch in the gas industry, the new service will provide gas facilities to communities where the manufactured or natural product has heretofore been unavailable.*

LATEST REPORT ON A.S.M.E. BOILER CODE

RECENTLY the American Uniform Boiler-Law Society of 253 Broadway, New York City, addressed the boiler inspection departments of code states and cities, asking what action they had taken or contemplated taking regarding the adoption or acceptance of the various sections of the American Society of Mechanical Engineers' Boiler Code. From replies received to date, the following information has been tabulated:

STATUS OF THE A.S.M.E. BOILER CONSTRUCTION CODE IN STATES, CITIES, DISTRICTS, TERRITORIES AND ZONES

	Power Boilers	Material Specifications	Locomotive Boilers	Low-Pressure Heating Boilers	Miniature Boilers	Rules for Inspection	Rules for Care of Power Boilers	Unfired Pressure Vessels
Rhode Island	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
New York	Yes	Yes	Yes	(4)	Yes	Yes	(2)	(2)
New Jersey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pennsylvania	Yes	Yes	Yes	Yes	Yes	Yes	(2)	(2)
Delaware	Yes	Yes	Yes	Yes	Yes	Yes	Yes	(2)
Maryland	Yes	Yes	Yes	(4)	Yes	Yes	(4)	Yes
Michigan	Yes	Yes	(4)	Yes	Yes	Yes	Yes	(4)
Ohio	Yes	Yes	Yes	Yes	Yes	Yes	Yes	(6)
Indiana	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wisconsin	Yes	Yes	(1)	Yes	Yes	(2)	(2)	(1)
Minnesota	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Missouri	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)
Washington	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)
Oregon	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
California	Yes	Yes	Yes	Yes	Yes	(3)	(2)	(6)
Utah	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Oklahoma	Yes	Yes	(4)	(4)	(4)	Yes	Yes	(4)
Arkansas	Yes	Yes	Yes	(4)	Yes	Yes	Yes	(4)
Dist. of Columbia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hawaii	Yes(5)	Yes(5)	Yes(5)	Yes(5)	Yes(5)	Yes(5)	Yes(5)	(2)
Detroit, Mich	Yes	Yes	(2)	Yes	Yes	(1)(7)	(1)(7)	Yes
Nashville, Tenn.	Yes	Yes	(2)	Yes	Yes	(2)	(2)	(3)
Scranton, Pa	Yes	Yes	Yes	Yes	Yes	Yes	(2)	(2)
Philadelphia, Pa	Yes	Yes	Yes	Yes	Yes	Yes	Yes	(2)
Omaha, Neb	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tampa, Fla	Yes	Yes	(2)	(2)	(2)	(2)	(2)	(2)
Memphis, Tenn.	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Seattle, Wash.	Yes	Yes	Yes	Yes	Yes	(2)	(2)	(3)
Kansas City, Mo.	Yes	Yes	(2)	(2)	(2)	(2)	(2)	(2)
Chicago, Ill	Yes	Yes	Yes	Yes	Yes	Yes	Yes	(3)
St. Joseph, Mo	Yes	Yes	(2)	(2)	(2)	(2)	(2)	(2)
St. Louis, Mo.	Yes	Yes	(1)	(1)	(1)	(1)	(1)	(1)
Erie, Pa	Yes	Yes	Yes	Yes	Yes	Yes	(2)	(4)
Los Angeles, Calif.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	(6)
Evanston, Ill	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parkersburg, W. Va.	Yes	Yes	(4)	(4)	(2)	(2)	(2)	(4)
Canal Zone	"It has been the practice to follow this code in the preparation of specifications for the purchase of boilers and boiler appurtenances, and it is believed this practice will be continued in the future."							

Yes —Adopted.
(1)—Will accept.
(2)—No action taken.
(3)—Under consideration.
(4)—No jurisdiction.
(5)—Hawaiian Sugar Planters' Association and other large interests.
(6)—Not entirely code. Communicate with state or city.
(7)—They suggest their use by owners.

Sue Power Commission to Prevent Cost Adjudication

The three secretaries composing the Federal Power Commission have been ordered to show cause, Nov. 7, before the Supreme Court of the District of Columbia why an injunction should not be granted the Clarion River Power Company of Johnstown, Pa., in connection with the proposed elimination of items of cost aggregating $6,387,731.57 incurred in the construction of the power company's Piney Branch project, the total cost of which was $11,032,-816.57, the company says.

The power company contends that the commission is acting in excess of its authority in adopting rules of practice which provide that in the event no protest is filed to a preliminary accounting report the commission may make such final order as may be appropriate and that unless the licensee submits evidence in support of its protest, the protest shall be deemed abandoned. Unless an injunction is issued to prevent the decision of the case, damages would be caused that would be incapable of adjudication at law. Hearings on the application were to have begun Nov. 5.

The items eliminated by the accounting division of the commission involve pre-license costs, as well as charges for general engineering and supervision, services of H. D. Walbridge & Company, certain financing costs and a number of other items pertaining to the construction period.

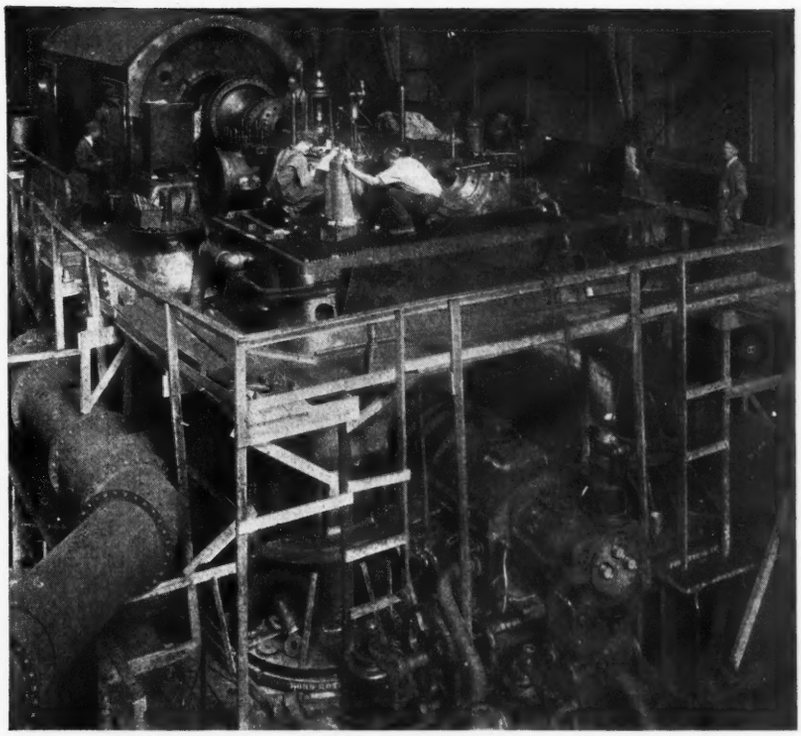
A.I.E.E. to Meet at Louisville, Nov. 19-22

The Southern District of the American Institute of Electrical Engineers will hold a four-day meeting at Louisville, Ky., Nov. 19 to 22, with headquarters at the Brown Hotel. Many interesting engineering subjects will be discussed at the five technical sessions under the following heads: industrial power applications, transportation, transmission and distribution, protective devices and selected subjects. The social features of the meeting consist of an informal smoker, a dinner-dance and special entertainment for the ladies.

Three papers will be presented at the industrial power applications session on Wednesday morning, Nov. 19. They are: "Electric Power in the Cement Industry," by R. H. Rogers; "Electric Power in the Lumber Industry," by A. H. Onstad, and "A Modern Rubber Mill," by N. A. Nigosin. Included among the papers to be given at the transmission and protective devices sessions are: "Lightning Investigation at Alcoa, Tenn.," by J. E. Housley; "Protection of Three-Winding Power Transformers," by R. E. Cordray, and "Power Transformer Noise—Its Characteristics and Reduction," by R. B. George.

Among the selected subjects to be discussed are: "Governor Characteristics Under Varying Load Conditions," by R. C. Buell, R. J. Coughery, E. M. Hunter and V. M. Marquis; "The Ohio Falls Hydro-Electric Station at Louisville, Ky.," by R. M. Stanley and E. D. Wood; "Modern Steam Stations of the Duke Power Company," by M. E. Lake; "Progress in the Design of Single-Phase Railway Motors," by H. G. Jungk, and "Automatic Arc Welding in the Electrical Industry," by G. H. Koch.

LARGEST INDUSTRIAL TURBINE



ASSEMBLING the 1,200-lb., 1,800-r.p.m., high-pressure element of the 110,000-kw., vertical-compound turbine-generator for the Ford Motor Company at the Schenectady Works of the General Electric Company for factory tests. The double-flow, low-pressure turbine and generator are directly beneath the high-pressure turbine and generator.

Besides being the largest industrial turbine-generator, the largest vertical-compound machine and the largest turbine-generator to operate on 1,200 lb. steam pressure, it is also the most compact unit yet built. Two older generating units, rated at 12,500 kw. each, will be moved out to make room for the new machine, which will occupy approximately the same amount of floor space.

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To Survey Power Needs of District of Columbia

Work on a survey to determine the power needs of the District of Columbia government will begin within a month or six weeks, according to statements made recently by the Engineer Commissioner's office. An appropriation of $25,000 to finance the survey was made available by Congress last session.

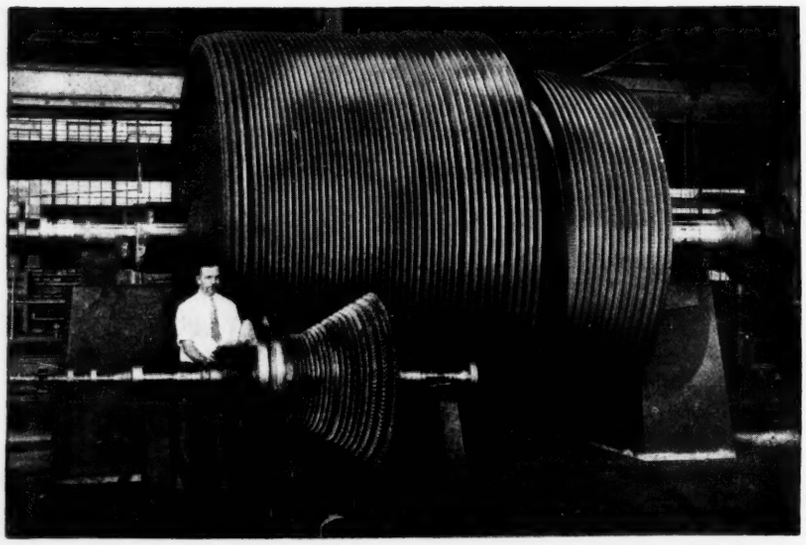
The District Government now buys current from the Potomac Electric Power Company. The survey was authorized for the purpose of determining whether the power needs of the government can be supplied more cheaply by a municipal plant.

Five electrical engineering firms have submitted proposals for conducting the survey. They are Burns & McDonnell Engineering Company, Kansas City; the Scofield Engineering Company, Philadelphia; Ford, Bacon & Davis, New York City; Smith, Hynchman & Grylls, Detroit; and the Public Service Institute, by C. C. Mayer of Washington. Decision will be made in the near future as to which firm the award will be given.

Diesel Runs 385 Days

An unusually long service run was completed recently when a Busch-Sulzer diesel engine stand-by unit in the hydro-electric plant of the Elko-Lamoille Power Company at Elko, Nev., was shut down after having been in service for 385 days. In continuous operation during the entire time, the engine functioned perfectly, requiring no adjustment of any of its parts and showing practically no wear at the bearings.

GIANT AND PIGMY DELIVER SAME HP.



Propelling turbine spindles for United States warships. The larger, a low-pressure direct-connected rotor of the battleship Pennsylvania, is being rebalanced at the South Philadelphia Works of the Westinghouse Electric & Manufacturing Company; the smaller, a high-pressure spindle, which drives a ship's propeller through reduction gearing, has just been constructed at the same works. Each delivers approximately 7,000 hp., the larger at about 240 r.p.m. and the smaller at 3,600 r.p.m.

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Construction at Battersea Now Under Way

After eighteen months of excavation work on the site of the new Battersea power station of the London Power Company, the erection of the main building columns has now been started, and by the end of the year the foundations, water tunnels, cable ducts and general preparation of the site should be practically completed. Three months later, work on the ferro-concrete coal jetty, 400 ft. long, is expected to be finished. A tender for the entire superstructure of the station has just been accepted. Nearly all the steam and electrical plant for the first section has been ordered, and though contracts have still to be placed for certain minor portions of the equipment it is hoped that everything will be ready for the station to be placed in service in about two years' time.

The first section will have room for three turbine-alternators, each of about 70,000 kw. capacity. Two of these have been under construction for some months past. The boiler house will have space for nine boilers, each with a normal capacity of 250,000 lb. of steam per hour and a maximum output of 330,000 lb. Two boilers will supply steam to each of the generator sets, with a third boiler in reserve. Both generators and boilers will be among the largest yet installed in the United Kingdom.

Dr. S. L. Pearce, chief engineer of the London Power Company, and designer of the station, is satisfied that the fumes problem at Battersea has now been solved as the result of the research work undertaken by the company under his direction. The process evolved has been patented throughout the world, and it is confidently anticipated that there will be no appreciable quantities of sulphur fumes, grit, or dust in the effluent from the great chimneys.

Arapuni Project Is Sound, Says Professor Hornell

Professor Hornell, the Swedish expert consulted by the New Zealand Government regarding the location of the Arapuni hydro-electric station, has just issued his report. He states that the locality is very suitable for the economic development of hydro-electric power, and the physical conditions of the country by no means exclude the possibility of creating a successful water-power station on the site.

The works as executed, he says, have been designed in accordance with sound engineering principles, and, so far as can be seen from visual inspection on the site, the constructional work has been well carried out. He has enumerated the repairs he considers essential, but has not calculated their cost.

The Arapuni inquiry is the result of the discovery last June that a fracture had occurred in the bank of the overflow channel below the spillway of the Arapuni power works. In a report to the London representative of his firm of consulting engineers (Vattenbyggnadsbyran, of Stockholm), Professor Hornell says that the prime cause of the earth movement at the works was the absorption of water that had penetrated the ground from the head race. He adds that the stability of the main dam, spillway intake and power house remain unimpaired.

Wyman Dam Primary Unit Ready This Fall

With their objective of having the primary unit ready to furnish power by the end of the year, 1,500 workmen are continuing their day and night shifts on Central Maine Power Company's new Wyman Dam near Bingham. Present construction schedules call for completion of the dam, which will provide 100,000 hp. for Maine industries and homes, early next spring.

Work has so far progressed that the first temporary waterway used in diverting the flow of the river to permit closing up the main channel, has been closed, and water is now going through the second channel. This closing up of waterways is always a critical period in hydro-electric work, and the fact that this has been accomplished marks a decided step toward the final completion of the dam.

A portion of the steel framework for the generating station has been put in place and a large gantry crane has been erected.

Vernon, Calif., Votes Money for City Power Plant

At a recent special election in the City of Vernon, Calif., $3,900,000 in bonds were voted to construct a municipal power plant and distribution system. Vernon is an industrial city almost wholly surrounded by the City of Los Angeles. Of some 125 votes in the community, 67 were cast at the special election, 64 for and three against the bonds.

There is a total load of approximately 50,000 kw. in the city, and it is the avowed intention to serve this by diesel engine driven generators.

New Unit for Brazil Plant

The Canadian General Finance Company, Ltd., of Toronto, Ont., has just placed a contract with the J. M. Voith Company of Heidenheim, Germany, covering No. 3 unit for its Serra hydro-electric plant near San Paulo, Brazil. The new unit will be of the impulse type and will develop 60,000 hp. under a head of 2,231 ft., at a speed of 360 r.p.m. The first two units in this station have a capacity of 40,000 hp. and were built by the Pelton Water Wheel Company.

Boiler, Stoker and Burner Sales Show Decline

New orders for steel boilers placed during the first nine months of 1930 covered 10,386 boilers with a square footage of 11,321,993, compared with 14,546 with a square footage of 15,557,547 for the corresponding period of 1929, according to the Department of Commerce. September orders show a similar decrease from those for August, with a total of 1,254 boilers of 1,282,388 sq.ft. against 1,371 of 1,356,751 sq.ft., and compared with 1,910 of 1,957,257 sq.ft. for September, 1929.

The following table, prepared by the Department of Commerce from reports of 81 manufacturers who comprise most of the leading firms in the industry, gives the number and square footage of each kind of boiler ordered during the first three-quarters of 1930, including comparisons with the corresponding period of last year:

	Total 9 Mos. 1930		Total 9 Mos. 1929	
	No.	Sq.Ft.	No.	Sq.Ft.
Stationary				
Water tube...	906	4,815,193	1,339	7,692,059
Horizontal return-tubular	739	1,002,906	1,102	1,458,504
Vertical fire-tube.....	897	275,840	1,204	361,559
Locomotive (not railway)	131	107,713	223	176,041
Steel heating.	6,181	2,775,864	9,098	4,259,188
Oil country...	856	976,736	844	861,134
Self-contained portable....	348	243,848	450	310,440
Miscellaneous.	117	103,318	126	78,052
Total.....	10,175	10,301,418	14,386	15,196,977
Marine				
Water tube...	149	979,926	69	273,705
Pipe.....	3	3,217	8	9,057
Scotch.....	52	33,504	72	64,245
2 and 3 flue...	.....	.....	2	1,350
Miscellaneous.	7	3,928	9	12,213
Total.....	211	1,020,575	160	360,570
Grand total	10,386	11,321,993	14,546	15,557,547

Sales of mechanical stokers for the first nine months of the year also show a loss, with totals of 963 stokers with a capacity of 294,559 hp. compared with 1,352 of 459,032 hp. for the first nine months of 1929. Shipments of oil burners likewise decreased, with 52,589 against 57,874 for the first three-quarters of last year. New orders for pulverized-fuel equipment for the nine months ended Sept. 30 amounted to 309 units with a total capacity of 1,635 tons per hour. As this is the first year that statistics have been compiled on sales of pulverized-fuel equipment, there are no figures available for comparison.

Sloan Advocates Higher Return on Utility Capital

"I would, in combination with strict and just regulation of operating utilities, endeavor to stimulate efficiency an economy of operation showing results in high-grade service at lowering prices by sanctioning a higher scale of reward to management and capital," declared Matthew S. Sloan, president of the New York Edison Company, in discussing the current situation in the electric industry at the Seventh Conference of Major Industries, held at the University of Chicago on Oct. 22.

Among the problems confronting the industry, he pointed out that the situation regarding public ownership was extremely important. "This situation to my mind," he said, "is of concern not alone to the electric utilities but also to all business because it affects or tends to affect the future growth and progress of this key industry. In the extreme, the demand for government ownership and operation of utilities presents an issue which is a challenge to a fundamental American principle on which all business is builded—the principle of private initiative and enterprise."

Asserting that all the questions involved in public ownership "will be settled by the American citizens whom the utilities serve," Mr. Sloan concluded his speech with the confident expression that, "As I read the history of the American people in business and in politics, I find nothing to make me question their collective wisdom."

Dedicate Steam Plant at Granite Falls, Minn.

Dedication of the new Minnesota Valley steam plant of Northern States Power Company at Granite Falls, Minn., was held on Oct. 13, when 174 officials of the company and visitors made a tour of inspection and enjoyed a dinner in the dining hall of the plant.

At the time of the dedication construction of the new plant was virtually completed. One of the two 10,000-kw. generators was installed and had been in operation for several weeks, while the second generator was ready to start within a few days.

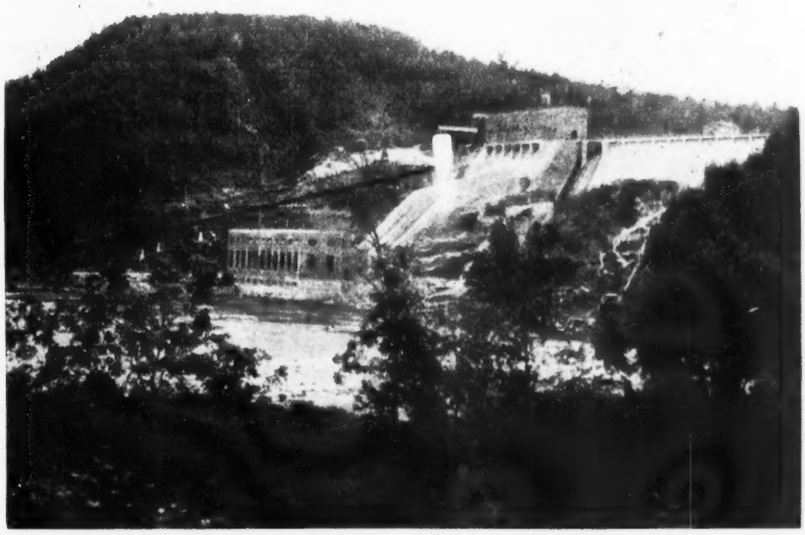
News of Canada

Contracts awarded for Minto mine-mouth plant — Ruskin unit started—Add to Maccan steam plant—Nipigon project nears completion

THE New Brunswick Power Commission has recently awarded contracts for various items of equipment for the new steam-electric plant the commission is erecting at Newcastle Creek on Grand Lake in the Minto coal area. The erection of a pit-mouth generating station to utilize New Brunswick coal was authorized some months ago by the government, and construction is now getting well under way, with excavation work completed and foundations going in.

It is understood that the total cost of the project will be in the neighborhood of $800,000. The plant will use pulverized coal, and the generators will deliver approximately 5,000 kw. Two 2,500-kw. turbine-generators are to be installed, and the current will be distributed for industrial and other uses in York, Sunbury and Queens counties. Construction of the new generating station is one of the most important recent developments in New Brunswick, as it will greatly aid the Minto coal-mining industry.

THE FIRST generating unit of the British Columbia Electric Railway Company's new hydro-electric plant at Ruskin, B. C., was turned over for the first time on Oct. 14, following the closing of the dam and filling up of the storage basin, which occupied the two previous days. Company officials state that the preliminary tests were entirely satisfactory. The success of twenty months'



At High Falls, Que., on the Lievre River, this plant was recently placed in operation by the James MacLaren Company, Ltd. It was designed for 120,000 hp. in four 30,000-hp. units, three of which are now installed and used to supply power and steam to the company's new 250-ton paper mill at Masson

construction work has been consummated with the new plant scheduled to go into commercial operation during the early part of November, delivering 47,000 hp. as the capacity of the first unit.

ADDITION of another unit to the Canada Electric Company's steam generating plant at Maccan, N. S., at a cost of $350,000 has been announced. The new unit will double the present capacity of the plant and not only will care for all present demands but also will anticipate future needs. It will not be necessary to increase the size of the plant, as provisions for additional units were made when the structure was built. Work on the new unit will begin at once. The properties of the Canada Electric comprise two steam generating plants at Chignecto and Maccan, with a total capacity of 9,000 hp., and over 30 miles of transmission lines.

APPROXIMATELY 54,000 hp. will be available from the Ontario Hydro Electric Power Commission's development on the Nipigon River with the final completion of the work at Alexander Rapids, where the 600-ft. earth-filled dam was recently closed. The first unit of this amount, 18,000 hp., will be available in a few weeks. The new dam is located at Alexander Landing, approximately 14 miles above Nipigon village, where the river takes a sharp "S" turn. It stretches across the river near the lower end of the rapids and will raise the level of the water about 60 feet.

Second Arc Welding Prize Contest Is Announced

Designers and engineers in every industry, where iron and steel forms all or a part of the manufactured product, are again given the opportunity by the Lincoln Electric Company, Cleveland, Ohio, to show their skill and ingenuity in utilizing the advantages of arc-welded construction. As a reward for their efforts $17,500 will be awarded for the 41 best papers submitted in the competition. The jury of awards, which will judge the papers entered in the competition, will be composed of the electrical engineering department of Ohio State University under chairmanship of Prof. Erwin E. Dreese, head of the department, and such others as he may select.

In announcing the second Lincoln Arc Welding Prize Competition the sponsors are establishing a biennial competition.

The forty-one prizes are: First prize, $7,500; second, $3,500; third, $1,500; fourth, $750; fifth, $500; sixth, $250; seventh to forty-first, $100 each. The competition is open to any person in the world except the employees of the sponsors. The closing date for entries is Oct. 1, 1931. Other details of the rules of the competition are expected to be announced shortly.

Natural-Gas Pipe Line to Albuquerque Completed

Construction of the 138-mile pipe line bringing natural gas to Albuquerque, N. M., from the San Juan basin has been completed. This pipe line, together with the 55-mile branch line from Santa Fe, represents an expenditure of approximately $5,000,000. The Southern Union Gas Company constructed this line and plans are being made for distribution through the present mains owned by the Albuquerque Gas & Electric Company. The agreement between the Southern Union Gas Company and the Albuquerque Gas & Electric Company has not been officially confirmed at this time, but when the confirmation takes place the Albuquerque company can begin its preparations for making the gas available to the city.

Five Cargo Vessels to Have New Propelling Units

Five 11,773-ton cargo vessels of the Baltimore Mail Steamship Company are now undergoing modernization at the Federal Shipbuilding & Dry Dock Company's plant in Kearny, N. J. Besides modifying the bow and stern lines of the ships, their old propelling units are being replaced by De Laval compound turbines and double reduction gears of 9,500 hp. capacity each. The new turbines are designed for a propeller speed of 95 r.p.m., which, it is estimated, will drive the ships at approximately 16 knots, instead of the original 11 knots. Steam is to be supplied from water-tube boilers at 250 lb. pressure, with 150 deg. superheat, and exhausted to a 28½ in. vacuum.

Dunston Contracts Placed

Large orders have recently been placed in connection with the projected new power station at Dunston-on-Tyne, England. Boiler installations to the value of $2,230,000 have been ordered at Gateshead, the contract for the twelve boilers required being divided between Clarke, Chapman & Company, and the Babcock & Wilcox Company. An order has also been placed with Richardsons, Westgarth & Company, West Hartlepool, for the condensing plant and auxiliaries required for the station, its value being over $450,000.

New Steam Plant for Japan

The Toho Electric Company of Japan plans to build in Kiushu Province a new steam-electric plant with an output of 25,000 kw. The new plant will cost approximately 3,000,000 yen, and will supersede the present plant, which will be used as stand-by, according to *Denkinotomo*, Japanese magazine.

Personals

R. J. S. PIGOTT has resigned as consulting engineer for Allied Engineers, Inc., of New York City, and has become staff engineer at the Gulf Research Laboratory. In his new position Mr. Pigott has charge of all engineering research at the laboratory.

H. E. MCDOWELL, who has been associated with the engineering department of the Texas Power & Light Company of Dallas, Texas, for the past ten years, has assumed new duties in the New York offices of the Electric Bond & Share Company. He will be sponsor engineer for the Texas and Arizona properties of Electric Bond & Share.

W. S. JOHNSTON, associated for the past four years with Allied Engineers, Inc., of New York City, has recently taken a position with the Stone & Webster Engineering Corporation at Boston as engineer in the mechanical division.

DEAN E. BATCHELDER, who has been in the engineering department of the Westinghouse Electric & Manufacturing Company of Pittsburgh, Pa., since 1928, has just been appointed instructor in electrical engineering at the State Agricultural School, Fort Collins, Colo.

S. M. VANCE, for the past two years industrial engineer for the Republic Light, Heat & Power Company at Tonawanda, N. Y., has joined the Natural Gas Pipeline Company of America. He will assist in making an industrial survey in and around Chicago. Mr. Vance was formerly an engineer with the Surface Combustion Company.

J. PAUL CLAYTON of Springfield, Ill., who has long been identified with the Middle West Utiilities Company and who is at present vice-president of the Central Illinois Public Service Company, has been elected president of the Illinois Chamber of Commerce.

C. T. CROCKER, formerly mechanical engineer in the aeronautics and marine department of the General Electric Company at Schenectady, N. Y., has been appointed designing engineer of the department.

JAMES H. RENIERS, formerly electrical engineer of the Pittsburgh Screw & Bolt Company of Pittsburgh, Pa., has been made assistant general superintendent of the company.

WILLIAM V. WEBER has resigned his position as chief electrical engineer of the American Welded Tube Company of Brilliant, Ohio.

R. J. COBBAN, since 1924 in charge of the central station division of the Westinghouse Electric & Manufacturing Company in Portland, Ore., has been appointed central station division supervisor of that company's San Francisco office. He succeeds W. P. L'HOMMEDEIU, who recently was made manager of this office.

Business Notes

WICKES BOILER COMPANY, Saginaw, Mich., announces the appointment of Charles A. Carpenter, 1124 Park Building, Pittsburgh, Pa., as its district representative for steel heating boilers.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces that orders received during the third quarter of 1930 amounted to $77,338,074, compared with $116,688,014 for the corresponding quarter of last year. Orders received during the first nine months of this year amounted to $267,651,832, compared with $337,404,470 during the corresponding period of 1929. Profit available for dividends on common stock for the first three quarters of 1930 was $42,518,709, against $47,965,832 for the first nine months of 1929.

LOUIS T. KLAUDER, consulting engineer, announces the opening of an office in the Trenton Trust Building at Trenton, N. J.

FULLER LEHIGH COMPANY, Fullerton, Pa., announces the removal of its Cincinnati, Ohio, office to the Carew Tower.

CHICAGO PNEUMATIC TOOL COMPANY, New York City, announces the completion of a modern completely equipped service station at 570 East Larned St., Detroit, Mich. The new sales and service station is housed in a two-story and basement building erected for the purpose, which contains approximately 12,000 sq.ft. of floor space.

THE FOXBORO COMPANY, Foxboro, Mass., announces the appointment of A. H. Shafer as manager of its Pittsburgh office. Mr. Shafer replaces H. S. Gray, who is now in charge of office routine at the home plant.

THE PANGBORN CORPORATION, Hagerstown, Md., announces that as a move to prevent unemployment and suffering in Hagerstown during the coming winter it has offered to loan the city $50,000 free of interest, to be expended for public work. The loan is conditioned upon the willingness of others to cooperate in the plan to the extent of raising an additional sum of $200,000.

F. S. B. HEWARD & COMPANY, LTD., Montreal, Que., announces its incorporation for the purpose of carrying on the sale, service and installation of steam plant, industrial, aeronautical and marine equipment. It represents the following firms: Allen-Sherman-Hoff, Ltd., of Montreal; Brown Brothers & Company, Ltd., of Edinburgh, Scotland; Diamond Specialty, Ltd., of Windsor, Ont.; Elliott Company of Pittsburgh, Pa.; James Howden & Company, Ltd., of Glasgow, Scotland; J. & E. Hall, Ltd., of Dartford, England; Rust Engineering Company, of Pittsburgh, Pa., and Thermotank, Ltd., of Glasgow, Scotland.

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COMING CONVENTIONS

American Society of Mechanical Engineers. Annual meeting in New York City, Dec. 1-5. National Fuels Meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. District meeting at Louisville, Ky., Nov. 19-22. Annual Winter convention in New York City, Jan. 26-30, 1931. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers. Annual meeting at the William Penn Hotel, Pittsburgh, Pa., Jan. 26-29, 1931. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

American Society of Refrigerating Engineers. Annual meeting at the Hotel New Yorker, New York City, Dec. 3-6. Secretary, David L. Fiske, 37 West 39th St., New York City.

International Acetylene Association. Annual convention at the Congress Hotel, Chicago, Ill., Nov. 12-14. Secretary, A. C. Morrison, 30 East 42nd St., New York City.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National Association of Practical Refrigerating Engineers. Annual convention and exhibition at the Hotel Peabody, Memphis, Tenn., Nov. 11-14. Secretary, Edward H. Fox, 5707 West Lake St., Chicago, Ill.

National Power Show. Grand Central Palace, New York City, Dec. 1-6. Manager, Charles F. Roth, Grand Central Palace, New York City.

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Trade Catalogs

CONVEYORS AND CHAINS—A new 176-page flexible-covered data book on belt conveyors has been prepared by the Link-Belt Company, 300 West Pershing Rd., Chicago, Ill., to facilitate the selection and application of the proper type of belt conveyor for handling materials in the quantities desired. It contains engineering charts, data and suggestions on the installation and maintenance of belt conveyors, together with dimensions and prices of the various types made by the company. The company has also issued a 32-page comprehensive data book, No. 1050, giving full data on chains for power transmission and conveying services.

BLOW-DOWN—Illustrated bulletin describing the National continuous blowdown and heat reclaimer, National Aluminate Corporation, 6216 West 66th Pl., Chicago, Ill.

REFRIGERATION MACHINERY—Bulletin No. 198-A illustrating and describing refrigerating plants used at ice skating rinks, Frick Company, Waynesboro, Pa.

WATER PURIFICATION — Illustrated bulletin giving full information on water purifying, filtering and softening systems developed by Hungerford & Terry, Inc., Clayton, N. J.

PACKING — Illustrated catalog showing rubber belting, packing, hose, matting and miscellaneous items manufactured by the Diamond Rubber Company, Akron, Ohio.

COMPRESSORS—Bulletin No. 151 illustrating and describing the construction and installation of duplex air and gas compressors, Pennsylvania Pump & Compressor Company, Easton, Pa.

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Fuel Prices

FUEL OIL

New York—Oct. 30, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Oct. 23, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.47 per bbl.; 28@30 deg., $1.595 per bbl.; 30@32 deg., $1.695 per bbl.; 32@36 deg., gas oil, 4.026c. per gal.; 38@40 deg., distillate, 4.651c. per gal.

Pittsburgh—Oct. 22, f.o.b. local refinery, 34@36 deg., fuel oil, 3.87½c.@4c. per gal.; 36@40 deg., 3.75c.@4c.

Philadelphia — Oct. 24, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 18 deg. plus, $1.475@$1.525 per bbl.; 23@27 deg., $2.00@$2.05 per bbl.

Cincinnati — Oct. 21, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Oct. 21, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 70c. per bbl.; 26@30 deg., 90c.@95c. per bbl.; 30@32 deg., $1.05 per bbl.

Boston—Oct. 27, tank-car lots, f.o.b. 12@14 deg., Baumé, 3c. per gal.; 28@32 deg., 5c. per gal.

Dallas—Oct. 25, f.o.b. local refinery 26@30 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York	$1.90 @ $2.25
Pool 10, hr.gr. low-vol.	New York	1.75 @ 1.85
Pool 11, low-vol.	New York	1.60 @ 1.75
Smokeless, mine-run	Chicago	1.75 @ 2.25
Smokeless, slack	Chicago	.50 @ 1.50
Harlan, Ky., slack	Chicago	.50 @ .90
Franklin, Ill., mine-run	Chicago	2.15
Franklin, Ill., screen	Chicago	1.00 @ 1.60
Ind. 5th Vein, m.-r.	Chicago	1.50 @ 1.85
Standard Ill., mine-run	St. Louis	1.50
W. Ky., mine-run	Louisville	1.00 @ 1.25
W. Ky., slack	Louisville	.25 @ .50
Pittsburgh, mine-run	Pittsburgh	1.30 @ 1.60
Smokeless, mine-run	Cincinnati	2.00 @ 2.25
Smokeless, slack	Cincinnati	.75 @ 1.35
Kanawha, mine-run	Cincinnati	1.10 @ 1.35
Kanawha, slack	Cincinnati	.30 @ .60

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat	New York	$3.50
Barley	New York	1.50

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ind., Angola—J. Brokaw, is having plans prepared for the installation of steam heating plant, etc., in theatre building. Estimated cost $35,000. A. M. Strauss, Fort Wayne, is engineer.

Ind., Greencastle—Greencastle Telephone Co., H. B. Wells, Mgr., plans improvements to substation including transformers, insulators, etc. Estimated cost $25,000. Work will be done by owner's forces.

Ind., Newcastle—Indiana Electric Corp., Traction Terminal Bldg., Indianapolis, plans the construction of an electric sub-station also high tension tower line from Indianapolis to Newcastle. Estimated cost to exceed $25,000. R. E. Brown, 110 North Illinois St., Indianapolis, is engineer.

Md., Baltimore—Mayor and City Council, City Hall, awarded contract for the construction of a 1 story, 29 x 42 ft. pumping station at Eastern Ave. and Pennsylvania R.R., Highlandstown, to DeCou & Chidlaw, 857 North Eutaw St. $19,739.

Mass., Boston—Beacon Laundry Co., 14 Lenox St., awarded contract for addition to boiler house to A. Bartington, 1 Washington St.

Mass., Fitchburg—Crocker, Burbank Co., 545 Westminster St., is having plans prepared for extension to power plant. Estimated cost $40,000. F. J. Sill, East Main St., Westboro, is engineer.

Mass., Framingham—Bd. of Public Works, A. C. Winch, Chn., will soon award contract for the construction of a pumping station and equipment at Reservoir No. 1, Winter St. Estimate cost $40,000. S. Dyer, Town Hall, is engineer.

Minn., Thief River Falls—City awarded contract for the construction of a power house to Dickinson Construction Co., Bemidji; also 35 kw. motor driven exciter set and switchboard, etc., to General Electric Co., 630 First National Soo Line Bldg., Minneapolis. Estimated total cost $80,000.

Mo., Clarkton—City plans an election Nov. 11 to vote $20,000 bonds for waterworks improvements including pumping station, pumping equipment, tank on tower, etc. W. A. Fuller Co., 2916 Shenandoah Ave., St. Louis, are engineers.

N. J., Jersey City—Bd. of Commissioners, City Hall, will soon award contract for the construction of a power house, laundry and tunnel at Baldwin and Montgomery Sts. Estimated cost $800,000. J. T. Roeland Jr., 30 Journal Sq., is architect.

N. J., Jersey City — Mongiello Bros., 625 Communipaw Ave., will receive bids about Dec. 1 for the construction of a 100 x 100 ft. ice plant. Estimated cost $50,000. C. H. Ziegler, 26 Journal Sq., is architect.

N. J., Trenton—City Commission, received low bids for two 20 m.g.p.d., De Laval centrifugal pumps, driven by 675 hp. 900 r.p.m. motors, one 200 kw. rotary converter, with switchboards and transformers, a.c. switchboard and 25 kva. single ph. transformer for waterworks. Estimated total cost $50,000.

N. Y., Newark — Dept. of Mental Hygiene, Capitol, Albany, awarded contract for heating work and additional boiler capacity to Heat Control Service, 3102 Clarendon Rd., Brooklyn, $70,900, also tunnel and service connections to Stewart & Bennett, 124 Water St., Rochester, $11,490, at Newark State School here.

N. Y., Rockaway — Dept. of Hospitals, Municipal Bldg., New York, will soon receive bids for the construction of a hospital including help quarters, power house, boilers, engines, generators and pumps at Rockaway Beach and 149th St. Blvd., here. Estimated cost $395,000. M. Bernstein, 2 Columbus Circle, New York, is architect. F. Sutton, 140 Cedar St., New York, is mechanical engineer.

Okla., Norman—Quix Kold Corp., Oklahoma Savings Bldg., Oklahoma City, is having preliminary plans prepared for a dry ice plant here. Estimated cost $40,000. Private plans.

S. C., Aiken—City plans extensions and improvements to power and light plant. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., are engineers.

Utah, Price—City plans the installation of a Deisel electric power plant, 300 kva. capacity. Estimated cost $30,000. Engineer not selected.

Wash., Seattle—Bd. of Public Works, will receive bids about January 1 for three pumping stations, etc. in connection with Lake Washington intercepting sewer system. Estimated cost $200,000. R. H. Thomson, is engineer.

Wyoming, Shoshone—Bureau of Reclamation, Denver, received low bids for a 5,000 kva. generator, four 1,667 kva. transformers, two gang operated disconnecting switches and one switchboard for Shoshone power plant, Shoshone Irrigation project.

Equipment Wanted

Generators—Arizona—Flagstaff Electric Light Co., G. T. Herrington, Gen. Mgr., Flagstaff, plans the installation of a 500 kva. generator in Flagstaff power plant, 500 kva. generator in Winslow plant and 1,000 kva. generator in Holbrook plant.

Pumping Equipment—Marble Falls, Tex.—R. Goeth, Marble Falls and Austin, plans to purchase pumping equipment, etc. for proposed waterworks.

Pumps—Schertz, Tex.—U. S. Government, c/o A. W. Parker, Constructing Quartermaster, will receive bids until Nov. 14 for four deep well pumps and three booster surface pumps and equipment, etc. for proposed waterworks improvements at Randolph Field.

Switchboard, Transformers, Transmitters, Etc.—Wellington, N. Z., General Post Office, Secretary Stores Division, will receive bids until Nov. 27 for 1,200 ft. cordage switchboard, 3 conductor redmounted, also until Dec. 9 for 200 transformers and until Dec. 15 for 150 transmitters.

Industrial Projects

Calif., La Verne—La Verne Co-Operative Citrus Assn., awarded contract for the construction of a 2 story, 90 x 106 ft. pre-cooling and packing plant. T. E. M. Mahl, La Verne. Estimated cost $75,000.

Calif., Los Angeles—Domestic Mfg. Co., 8800 Venice Blvd., awarded contract for a 2 story, 196 x 230 ft. factory to Hamm, Grant & Brunner, Inc., 607 Ferguson Bldg. Estimated cost $72,000.

Calif., South Gate—Rheem Mfg. Co., 4535 Horton St., Emeryville, is receiving bids for a 1 story, 210 x 400 ft., factory here. Estimated cost $100,000. Meyer & Holler, Wright-Callendar Bldg., Los Angeles, are architects.

Fla., Mulberry — International Agricultural Corp., 61 Broadway, New York, N. Y., is receiving bids for the construction of a phosphate plant here. Estimated cost $300,000. Private plans.

Ill., Chicago — Grigsby-Grunow Co., 5801 Dickens Ave., manufacturers of "Majestic" radios and electric refrigerators, has work under way on addition to power house facilities of its plant development to include an 850 hp. power boiler and equipment at North Austin and Dickens Aves. Estimated cost $125,000. J. R. Kehm Co., 8 East Austin Ave., is general contractor.

Ind., Evansville—County Commissioners, will receive bids until Dec. 4 for the construction of a new dairy plant, new power plant, stack, two steam boilers, etc. Estimated cost $65,000. A. E. Neucks, 604 Old State Bank Bldg., is architect.

Ind., Indianapolis—J. R. Barrett, Penn and Henry Sts., awarded contract for the construction of a factory at Pennsylvania and Henry Sts. to C. J. Wacker, 3228 Central Ave. Estimated cost $40,000.

N. Y., New York—Sensitive Electrical Instrument Co., 142 East 32nd St., plans the construction of a 60 x 140 ft. electrical research laboratory at Bronx Blvd. and Bullard Ave. Estimated cost to exceed $20,000.

N. Y., Port Ivory—Proctor & Gamble Co., 17 Battery Pl., New York, will soon award contract for a 1 story, 30 x 70 ft. addition to boiler house here. Estimated cost $40,000. Private plans.

O., Cleveland—Cleveland Lithograph Co., C. Morgan, Pres., East 17th St. and Payne Ave., awarded contract for a 1 story, 55 x 100 ft. factory at 1546 East 33rd St. to A. M. Higley Co., Plymouth Bldg. Estimated cost $40,000.

O., Cleveland—Powerlite Switchboard Co., J. F. Jirka, Secy. and Treas., 5149 East 71st St., awarded contract for a 1 and 2 story, 50 x 122 ft. factory and office to H. K. Ferguson Co., Hanna Bldg. Estimated cost $50,000.

O., Cleveland—Roberts Realty Co., M. Siegel, 1942 Woodward Ave., awarded contract for the construction of a 1 story, 47 x 108 ft. light reflector plant at 3856 Woodland Ave. to L. Fishman, 3413 East 142nd St. Estimated cost $40,000.

O., Columbus—Jaeger Machine Co., 520 Dublin Ave., awarded contract for the construction of a 1 story, 105 x 205 ft. factory to T. J. Schirtzinger, 1353 North High St. Estimated cost $50,000.

Ont., Barrie — Co-Operative Packers of Ontario, awarded contract for a 2 story, 85 x 135 ft. packing plant including refrigeration unit, etc., on Main St., to Webb & Son, Mississaga St., Orillia. Estimated cost $100,000. Interested in prices on complete equipment.

Ont., Cornwall — Cortaulds (Canada) Ltd., awarded contract for an additional factory building, 2 story, 150 x 450 ft. for the manufacture of rayon silk on Montreal Rd. to Foundation Co. of Canada, Sherbrooke St., Montreal, Que. Estimated cost $250,000.

Ont., Waterloo—E. O. Weber Furniture Co., Willow St., plans to rebuild 4 story furniture factory recently destroyed by fire. Loss $150,000. Complete equipment will be required.

Buildings

Calif., Hollywood—R. K. O. Radio Pictures Corp., plans the construction of a film laboratory and studio at Melrose St. Estimated cost $1,000,000. Architect not selected.

N. J., Asbury Park — Tillion & Tillion, 48 West 48th St., New York, N. Y., Archts., are receiving bids for the construction of a 6 story apartment building, including steam heating and refrigeration systems, boilers, elevators, etc., at Grand and 4th Aves. for C. E. Van Wickle, 501 Grand Ave., Asbury Park. Estimated cost $500,000.

N. J., East Orange—W. Okin c/o Ginsburg & Wolf, 845 Broad St., Newark, rejected bids for 10 story apartment building including steam heating system, etc. on South Munn Ave. here. Estimated cost $600,000. M. A. Wolf, 845 Broad St., Newark, is architect. Indefinite when project will mature.

N. J., Hackensack—Fox Metropolitan Playhouses, 850 10th Ave., New York, N. Y., will soon award contract for a 125 x 200 ft. theatre building including steam and ventilation systems, boilers, etc., at 311 Main St. here. Estimated cost $1,000,000. T. W. Lamb, 644 8th Ave., New York, N. Y., is architect.

N. Y., New York — Bethlehem Engineering Corp., 1560 Broadway, will receive bids about Dec. 1 for excavation and foundations, for an office building at 8th Ave. from 41st to 42nd Sts. Estimated total cost $5,000,000.

N. Y., New York—Carpenter-Madison Corp., J. H. Carpenter, Pres., 551 5th Ave., awarded contract for the construction of an office building to Dwight P. Robinson Co., 125 East 46th St. Estimated cost $2,000,000.

N. Y., New York — Chanin Bros., 122 East 42nd St., plans the construction of an apartment building at Central Park West and 62nd St. Estimated cost to exceed $8,000,000.

N. Y., New York—Gresham Construction Co., 18 East 48th St., Contrs., are receiving bids for excavation and foundations for an office building at 432 Madison Ave., for Almy Realty Co., 141 Broadway. Estimated total cost $3,000,000.

O., Dayton—Good Samaritan Hospital Association, c/o Sisters of Charity, awarded contract for the construction of a hospital, nurses home, service quarters, etc., on Fairview Ave., to C. H. Shook, Inc., Third National Bldg. Heating and plumbing, to H. J. Osterfeld Co., 413 South Main St.; coal and ash handling equipment, to R. I. Beaumont Co., Cleveland. Total estimated cost $1,500,000.

Tex., Fort Worth—Atchison, Topeka & Santa Fe Ry. Co., Topeka, Kan., is having plans prepared for a 50 x 400 ft. freight terminal and passenger station on Jones St. here. Estimated cost $1,000,000. W. W. Kelly, Amarillo, Tex., is chief engineer, Western Lines.